

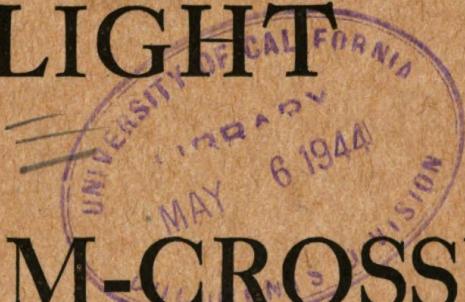
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TM 5-271

WAR DEPARTMENT TECHNICAL MANUAL

U.S. Dept of Army

LIGHT



STREAM-CROSSING

EQUIPAGE

WAR DEPARTMENT • 27 MARCH 1944

WAR DEPARTMENT TECHNICAL MANUAL

TM 5-271

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STREAM-CROSSING

EQUIPAGE



WAR DEPARTMENT

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27 MARCH 1944

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WAR DEPARTMENT,
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TM 5-271, Light Stream-Crossing Equipage, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
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OFFICIAL:

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As prescribed in paragraph 9a, FM 21-6: D (10); B (6); R 2, 4, 6, 7, 10, 17 (5); IR 5 (10); Bn 5 (5); I Bn 5 (10); C 5 (3); IC 5 (10).

IR 5: T/O 5-192, Engr Combat Regt.

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IC 5: T/O 5-87, Engr Ponton Co (L); 5-327, Engr Petroleum Distributing Co; 5-627, Engr Treadway Bridge Co; 5-17, Engr Combat Co (Sep).

For explanation of symbols see FM 21-6.

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CHAPTER 1

GENERAL

1. TECHNICAL DATA. **a.** This manual supplies technical information covering the construction, use, and maintenance of the following types of stream-crossing equipage:

- (1) Assault boat M2..
- (2) Storm boat.
- (3) Power utility boat.
- (4) Reconnaissance boats and 6-ton pneumatic float.
- (5) Infantry-support rafts and expedient assault-boat bridge.
- (6) Expedient rafts, constructed of pneumatic floats and plywood treadways.
- (7) Ferry set.
- (8) Footbridge M1938.

b. This manual also supplies technical information on the repair of plywood boats.

c. Technical Manuals covering other stream-crossing equipage are TM 5-272, 5-273, 5-274, 5-275, 5-276, 5-277, and TM 5-278 (when published).

2. TACTICAL DATA. **a.** Tactical considerations in stream crossings are covered in FM 5-6.

b. A forced stream crossing is in the following three phases:

- (1) FIRST PHASE. Crossing the first infantry troops by assault boats. Storm boats or transport aircraft may supplement the assault boats.
- (2) SECOND PHASE. Constructing infantry-support rafts to cross combat vehicles and weapons carriers. Some assault boats continue in operation. Whenever practicable, a footbridge is constructed during this phase. In some instances expedient assault-boat bridges may be constructed of infantry-support-raft equipage before ponton bridges are built.
- (3) THIRD PHASE. Constructing ponton bridges after ground-observed artillery fire and all small-arms fire have been eliminated from bridge sites. Rafts may be continued in operation.

CHAPTER 2

ASSAULT BOAT M2

3. PURPOSE AND USE. Assault boats are light, easily transported craft used to carry the leading elements of the assault in a forced stream crossing. M2 assault boats are also used in construction of infantry-support rafts and expedient assault-boat bridges.

4. ASSIGNMENT. See appropriate Tables of Equipment and FM 5-35.

5. DESCRIPTION. a. Design features. (1) The assault boat M2 (figs. 1 and 2) is a scow type plywood boat with square stern, flat bottom, and slightly tapered bow. Each boat has two hinge connections and one boat-connecting pin so two boats can be coupled stern-to-stern to form an assault-boat ponton. Two treadway spacers, to space the plywood treadways, are located in each gunwale of the assault boats for use when the boats are part of a raft or bridge.

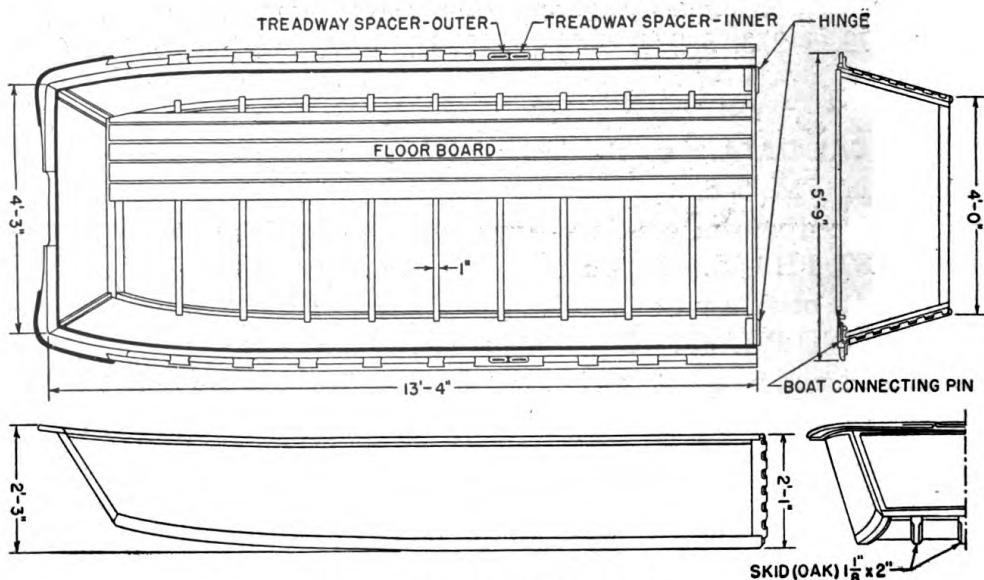


FIGURE 1. *Assault boat M2.*

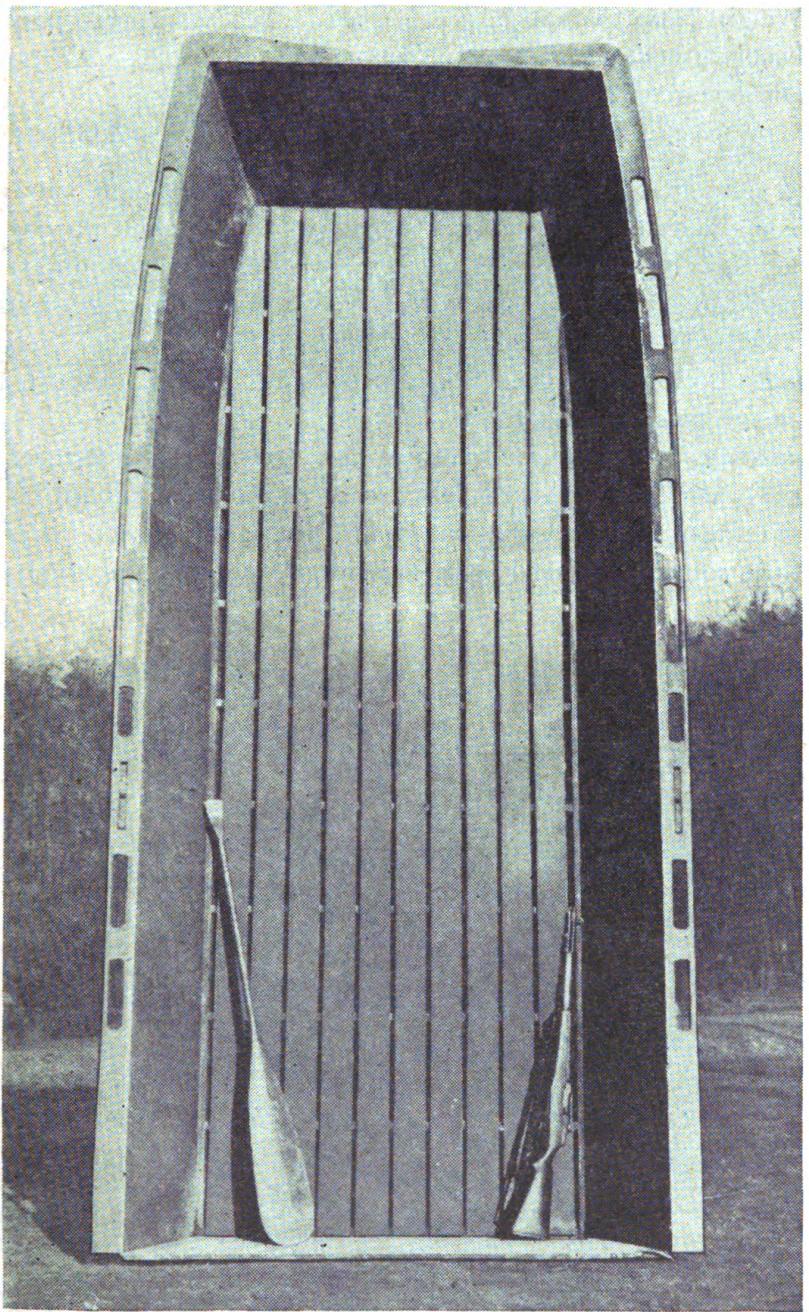


FIGURE 2. *Interior view of assault boat M2.*

(2) The assault boat M2 has the following characteristics:

Maximum width	5 feet 4 inches.
Over-all length	13 feet 4 inches.
Depth	2 feet 1 inch.
Weight (approximate)	410 pounds.
Displacement with a 4-inch freeboard	5,300 pounds.
Displacement with an 8-inch freeboard (approximate)	4,000 pounds.

(3) The sides of the assault boat are $\frac{7}{16}$ -inch mahogany plywood, the bottom is $\frac{3}{8}$ -inch fir plywood, and the transom is $\frac{3}{4}$ -inch fir plywood. The corner edges of the bottom, sides, and ends of the boat are bound with brass angle-strips fastened to the boat with screws and rivets. The inside of the bottom is floored with oak slats attached to the frames. The strip skids, fixed to the bottom for protection during loading and transport, are oak. The boats are painted olive drab.

b. Capacity. (1) A three-man engineer crew operates the assault boat M2 (fig. 3), which will carry safely any of the following loads of combat-equipped infantrymen and weapons *in addition to* the crew:

(a) Rifle squad (12 men) with individual weapons and combat equipment (fig. 4).



FIGURE 3. Assault boat being paddled by 3-man engineer crew.

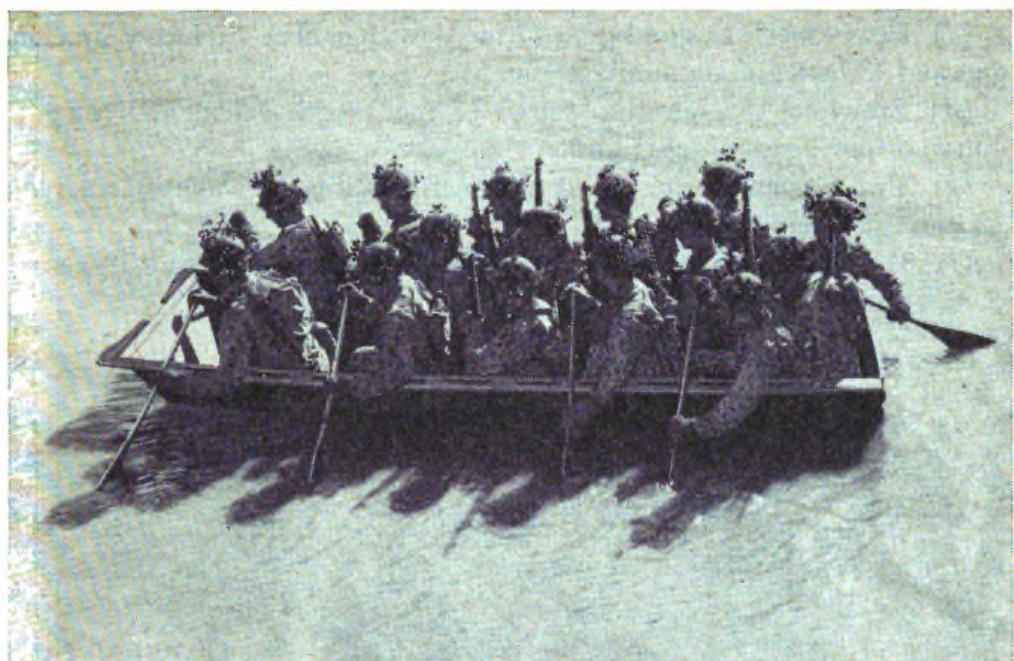


FIGURE 4. Assault boat carrying 12 infantrymen and 3-man engineer crew.



FIGURE 5. Assault boat carrying 7-man heavy machine-gun squad, 3-man engineer crew, heavy machine gun caliber .30, and 13 boxes of ammunition.

- (b) Two light machine-gun squads (10 men) with two caliber .30 light machine guns and 20 boxes of ammunition.
- (c) Heavy machine-gun squad (7 men) with caliber .30 heavy machine gun and 13 boxes of ammunition (fig. 5).
- (d) Browning machine-gun squad (7 men) with caliber .50 machine gun and four boxes of ammunition.
- (e) Two 60-mm mortar squads (10 men) with two 60-mm mortars and 72 rounds of ammunition.
- (f) 81-mm mortar squad (7 men) with 81-mm mortar and 50 rounds of ammunition (fig. 6).



FIGURE 6. *Assault boat carrying 7-man 81-mm mortar squad, 3-man engineer crew, 81-mm mortar, and 50 rounds of ammunition.*

- (g) Infantry communication platoon wire section (8 men) with complete equipment.
- (2) Two assault boats lashed together carry the 37-mm antitank gun with its 5-man squad, an engineer crew of at least 3 men, and at least 100 rounds of ammunition (figs. 7 and 8).

6. CARRYING. Ten to 12 combat-equipped soldiers carry the boat, special weapons, equipment, and ammunition. The boat is carried inverted to a point several yards from the stream (fig. 9) where it is turned over, carried to the water's edge, and launched.

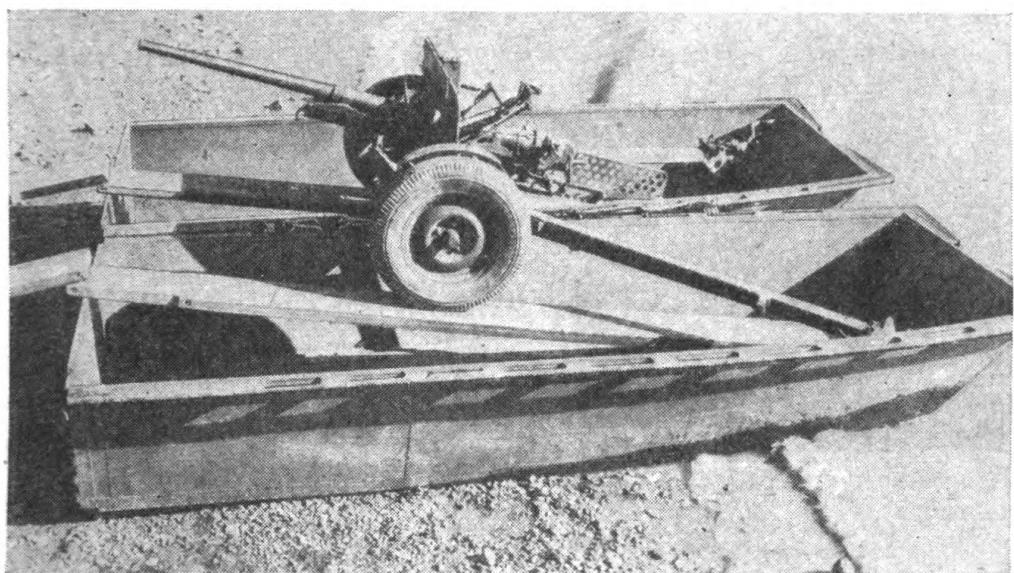


FIGURE 7. Assault boats being loaded with 37-mm antitank gun.



FIGURE 8. Assault boats carrying 5-man antitank gun crew, 3-man engineer crew, 37-mm antitank gun, and 100 rounds of ammunition.



FIGURE 9. *Assault boat M2 carried inverted.*

7. PADDLING. a. Three-man engineer crew. The engineer in charge of the boat kneels at the stern, and steers. The other crew members kneel at either side of the bow, and paddle.

b. Passengers. Six passengers also paddle.

8. TRANSPORTATION. The boats are nested for transportation. They may be carried on 2½-ton trucks or on two-wheel trailers.

9. CARE OF EQUIPMENT. a Handling. (1) Assault boats are less rugged than heavier types of small boats and must be handled with care. (2) The treadway spacers break easily. Striking them with a treadway must be avoided.

b. Repairs. See chapter 5.

c. Maintenance. Issue olive-drab paint is satisfactory. The boat's few seams are well protected by construction and by metal strips so recalking seldom is required. When necessary, a standard marine calking compound such as canoe glue is used. Calking cotton never should be used in these boats.

10. STORAGE. The boats should be stored under cover, protected from sun and weather. Before being stored for protracted periods they should be dried, cleaned, inspected, and, if necessary, repaired and painted. If space is limited, boats may be nested in stacks of not more than 12. The bottom of the lowest boat in each stack must be choked carefully to support it and to allow free circulation of air.

11. ASSAULT BOAT M1. The assault boat M1 (fig. 10) has been superseded by the assault boat M2. Since a considerable number of these boats still are in use, this boat is described briefly below.

a. (1) The M1 boat is a skiff type, flat-bottomed boat constructed of plywood. It is 13 feet 6 inches long, weighs about 200 pounds, and with a 5-inch freeboard has a displacement of approximately 3,000 pounds (slightly less than that of the M2 assault boat).

(2) It will carry safely, *in addition to* the two-man engineer crew, any one of the following loads of combat-equipped infantrymen and weapons:

(a) Nine riflemen with individual weapons.

(b) Eight men, 1 caliber .30 light machine gun, and 20 boxes of ammunition.

(c) Eight men, 1 caliber .30 heavy machine gun and 13 boxes of ammunition.

(d) Eight men, one caliber .50 machine gun, and four boxes of ammunition.

(e) Seven men, one 81-mm mortar, and 50 rounds of ammunition; or 9 men, one 60-mm mortar, and 150 rounds of ammunition.

(f) Seven men and equipment of infantry communication platoon wire section.

b. The M1 assault boat does not have hinge connections for making assault-boat pontons.

12. ASSAULT BOAT M3. A lighter, more maneuverable assault boat is under development.

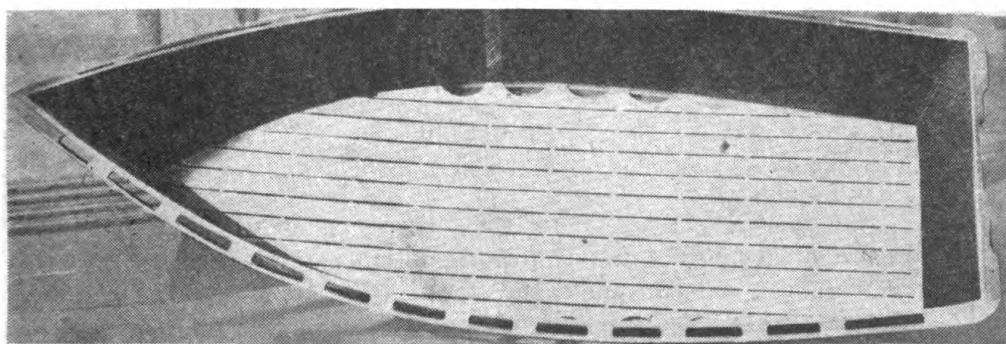


FIGURE 10. *Interior view of assault boat M1.*

CHAPTER 3

STORM BOAT

13. PURPOSE. The storm boat (fig. 11) is an assault craft designed to transport personnel in forced crossings of wide streams, lakes, and other sheltered waterways, when secrecy must be sacrificed for speed.

14. DESCRIPTION. **a. Boat.** The storm boat is an extremely rugged boat built of high-strength plywood, with internal bracing consisting of a keel and a series of frames extending from the keel to the sides in herringbone fashion. The boat has a tapered bow and a blunt stern. A double bottom divided into watertight compartments gives it additional strength. The bottom is reinforced by a series of scuffing strips. A handrail for carrying adds rigidity to the sides of the boat. The storm boat has the following characteristics:

Length (over-all) -----	16 feet 9 inches.
Width (maximum) -----	6 feet 6 inches.
Depth (maximum) -----	1 foot 10 inches.
Weight (approximate) -----	440 pounds.
Safe allowable load-----	1,860 pounds.

b. Motor. (1) The storm-boat motor is a high-powered outboard motor with the following general characteristics:

- Four-cylinder.
- Fifty-horsepower.
- Water-cooled.
- Flywheel type magneto ignition system.
- Four-gallon, self-contained fuel tank.
- Weighs approximately 200 pounds.

(2) It has a special type bracket for mounting on the storm boat. When the motor is in use the bracket is attached to the stern (fig. 12); when not in use it folds back on the floor of the boat (fig. 13). The motor is rope-started, and is fueled by a mixture having a pint of lubricating oil to a gallon of gasoline. Starting instructions are inscribed on a plate attached to the motor hood.

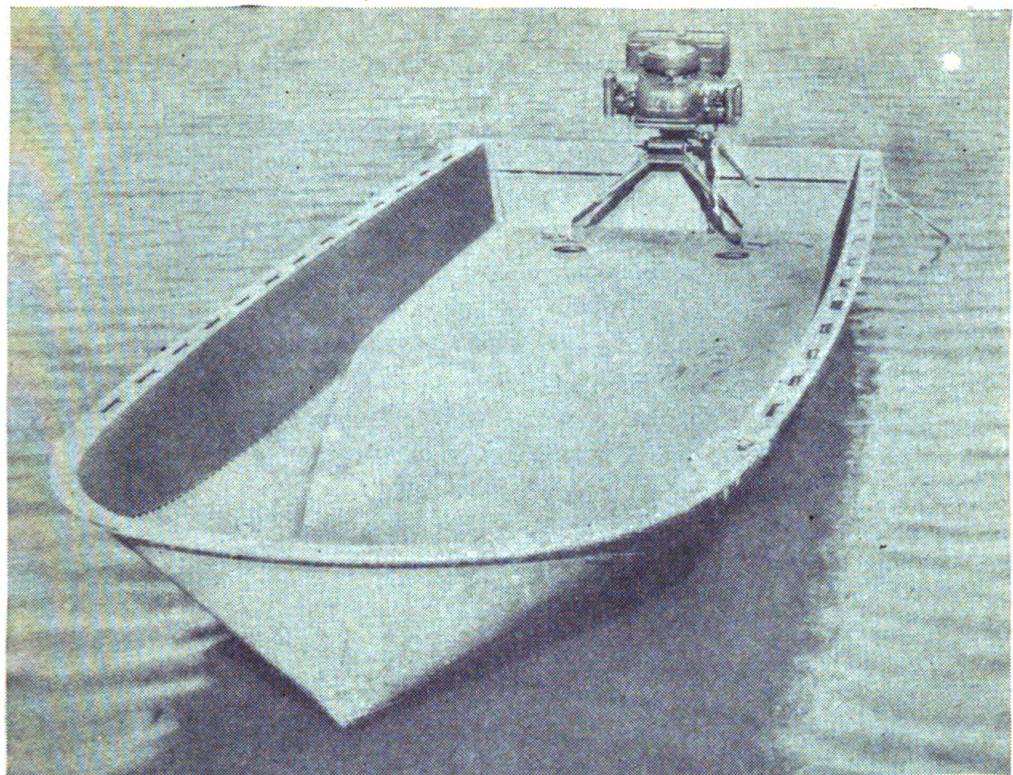


FIGURE 11. *Storm boat with motor.*

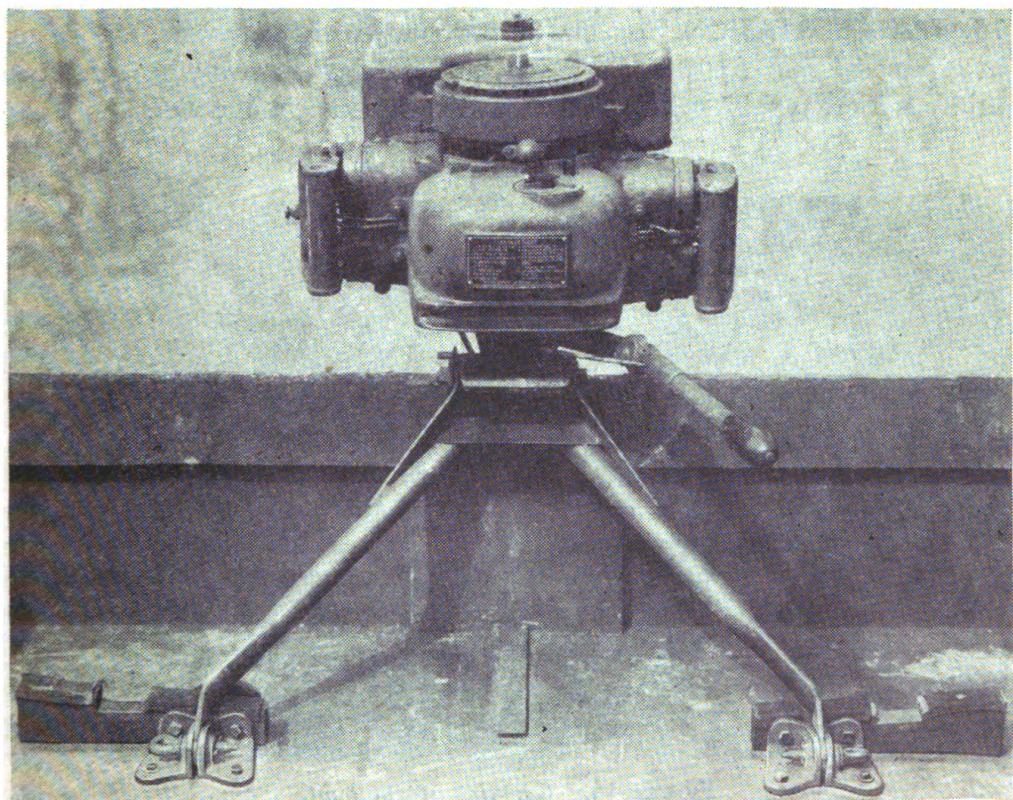


FIGURE 12. *Position of motor in use.*

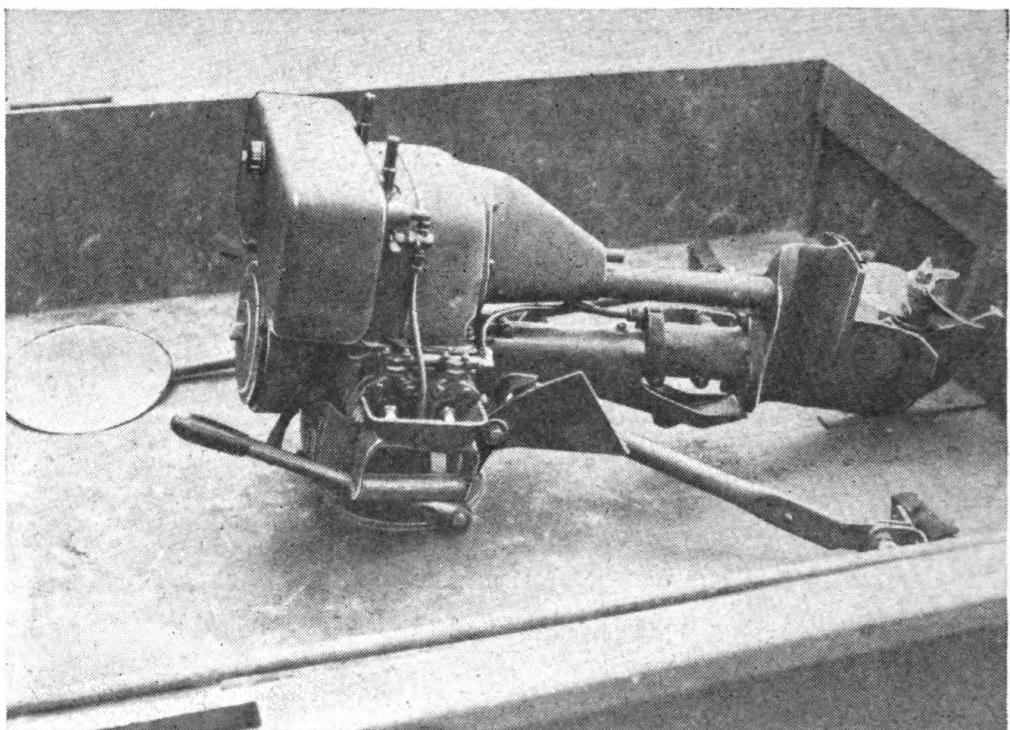


FIGURE 13. *Position of motor not in use.*

15. TRANSPORTATION. **a.** The storm boats, without motors, are nested in groups of four for transportation, and carried on two-wheel poletype utility trailers type V. Motors are carried in the prime movers.



FIGURE 14. *Carrying storm boat.*



FIGURE 15. *Storm boat in operation, loaded with crew and seven fully equipped riflemen.*

b. The boat is readily manhandled off the trailers. The motor with its bracket attached is placed inside the boat which is carried to the water's edge by men grasping the carrying rail (fig. 14).

16. EMPLOYMENT. **a. Crew.** The crew consists of an operator and a bowman. Both should be well trained in operation, employment, and repair of the boat, and in maintenance of the motor.

b. Passengers. In addition to its two-man crew the boat will carry any one of the following loads:

- (1) Seven fully equipped riflemen (fig. 15).
- (2) Light-machine-gun squad of 5 men, 2 additional men, 1 caliber .30 light machine-gun, and 10 boxes of ammunition.
- (3) Heavy-machine-gun squad of seven men, one caliber .30 heavy machine-gun, and nine boxes of ammunition.
- (4) 60-mm mortar squad of 5 men, 2 additional men, one 60-mm mortar, and 36 rounds of ammunition.
- (5) 81-mm mortar squad of 7 men, one 81-mm mortar, and 24 rounds of ammunition.
- (6) One 37-mm antitank gun, 2 men, and 20 rounds of ammunition (fig. 16).

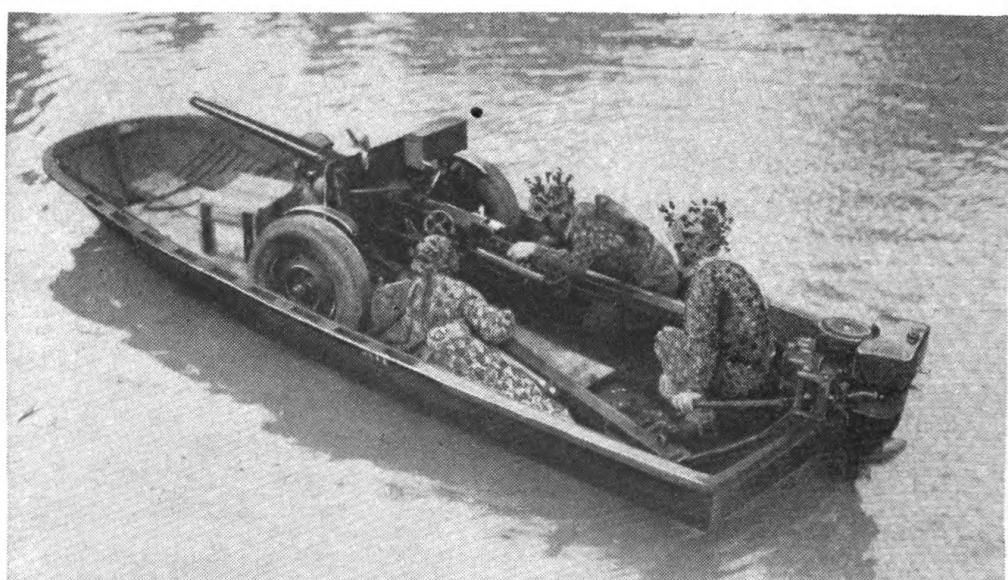


FIGURE 16. *Storm boat in operation, loaded with crew, 37-mm antitank gun, and two men.*

c. Cargo. The storm boat can be used to ferry ammunition, fuel, and other vital supplies at great speed. Its most efficient cargo capacity, in addition to its two-man crew, is 1,860 pounds. The cargo should have the lowest possible center of gravity, and should not be piled higher than the gunwales.

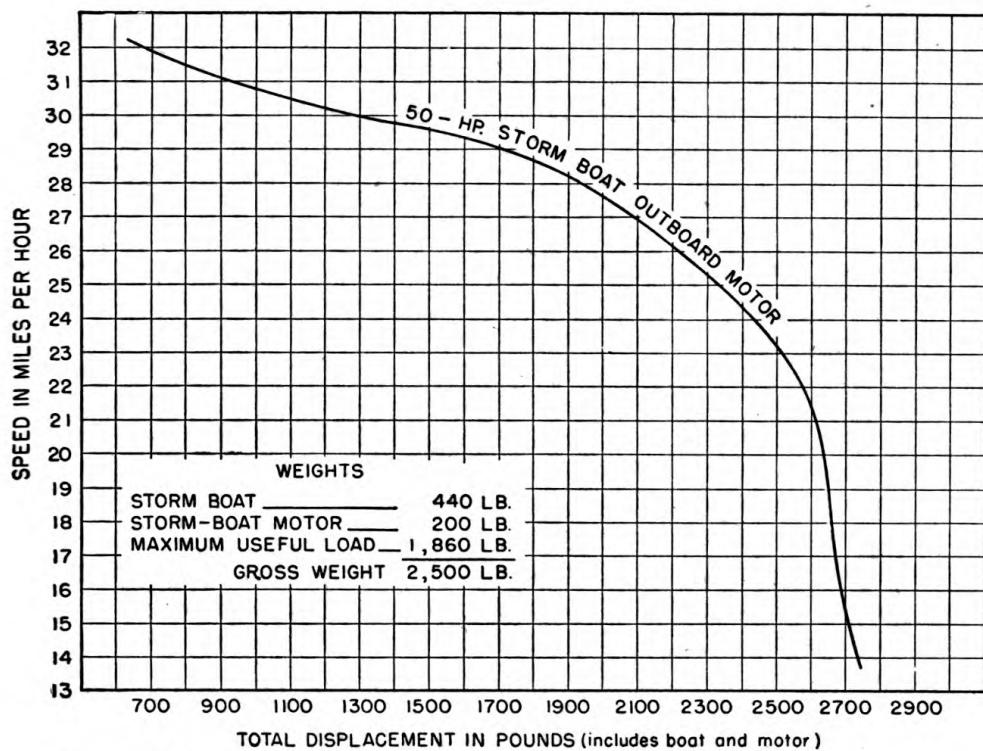


FIGURE 17. *Velocity-displacement chart of performance of storm boat.*

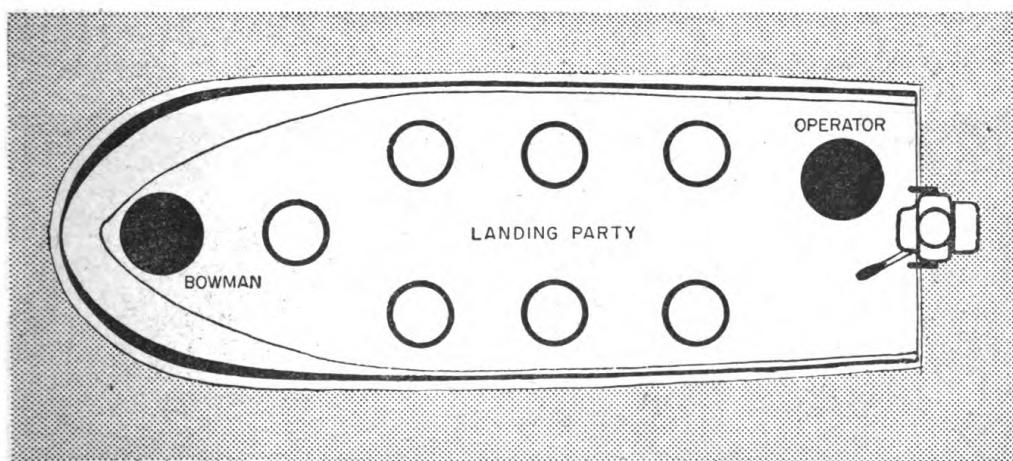


FIGURE 18. *Correct position of landing party and crew in storm boat.*

d. Performance. The storm boat attains a speed of 30 to 35 miles per hour carrying only its two-man crew, and 20 to 24 miles per hour when carrying any of the loads described in b and c above. Any appreciable increase in weight greatly reduces the speed of the boat (fig. 17).

e. Positions in boat (fig. 18). (1) The operator should kneel to one side of the motor and steer with his left hand (fig. 19). To take any

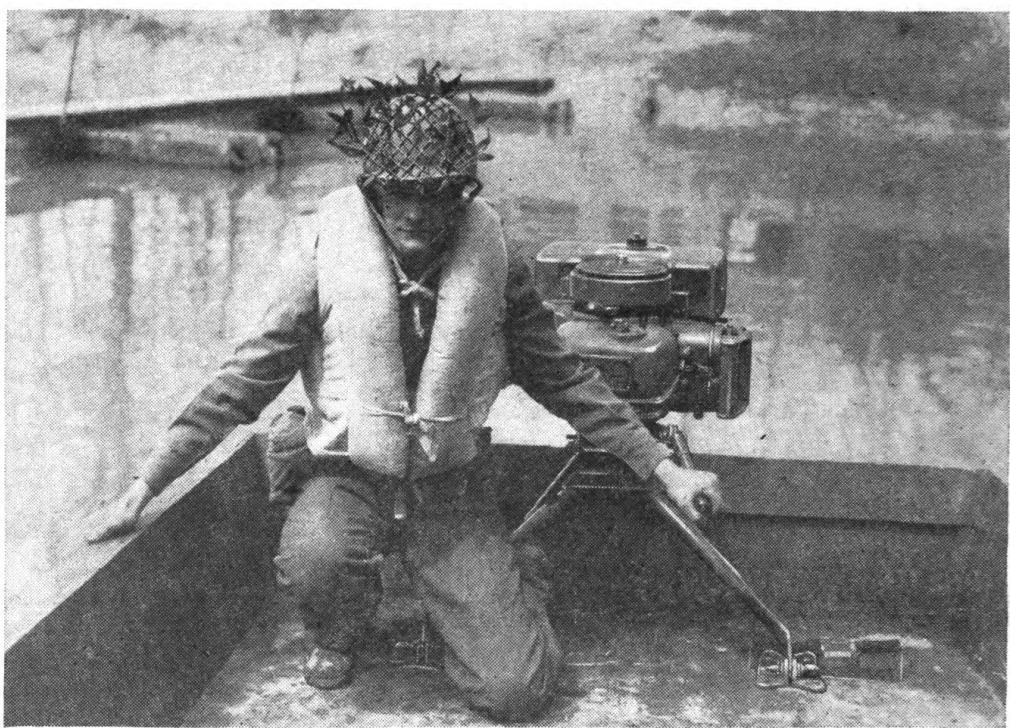


FIGURE 19. *Correct position of operator in storm boat.*

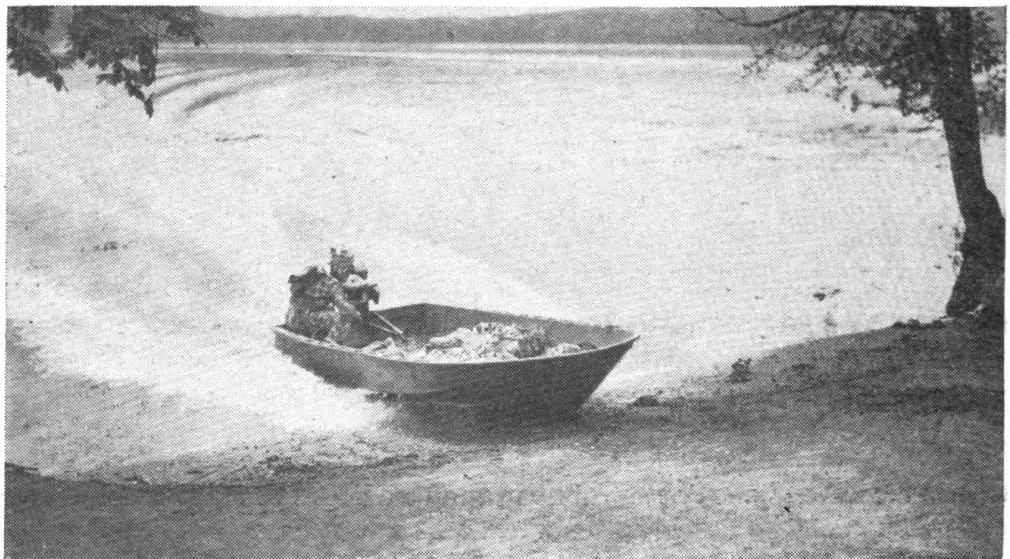


FIGURE 20. *Beaching storm boat under power.*

other position, or to steer with his right hand, limits the maneuverability of the boat and the pivoting of the motor, and endangers the safety of the operator and passengers because the motor and bracket have a tendency to pivot forward when the boat is beached under power.

(2) Other personnel must lie on the bottom of the boat so as to present a minimum target to the enemy. It is possible for the motor and bracket to become disengaged accidentally from the stern and to swing forward into the boat. Therefore, occupants should not lie on the floor of the boat immediately in front of the motor.

f. Landing the boat on far shore. (1) On gently sloping banks the boat may be beached at full throttle (fig. 20). The motor is stopped by the operator immediately before the bow of the boat grounds. The boat is headed directly into the beach so the bow will ground squarely. After beaching, the boat can be returned to the water by its two-man crew.

(2) Where shore conditions or tactical requirements prevent beaching, the motor is cut off in the normal manner and the boat is maneuvered as close as possible to the bank for unloading. This is the *normal procedure* when the boats used in the initial wave are to be used in successive waves.

17. MAINTENANCE. **a. Storage.** Storm boats should be stored in the same general manner as the assault boat M2. For details, see paragraph 10.

b. Repair. For boat repairs, see chapter 5. For motor maintenance and repair, see TM 5-8010 and TM 5-278 (when published).

CHAPTER 4

POWER UTILITY BOAT

18. PURPOSE. The power utility boat (fig. 21) is designed for general utility in building floating bridges. It is also valuable for ferrying operations and for powering ponton and pneumatic rafts.

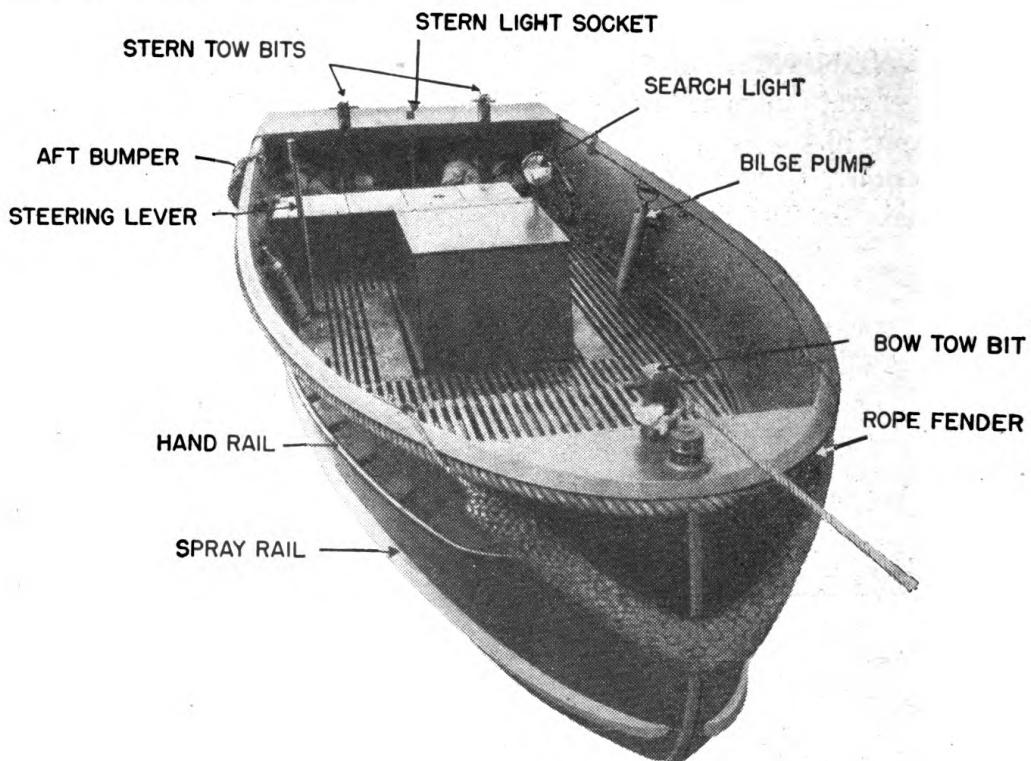


FIGURE 21. *Power utility boat.*

19. DESCRIPTION. a. Boat. The hull is made of molded plywood, which is strong and light and without seams. It has a rope bumper and a carrying rail. The bow is full and round, and provides ample buoyancy and contact in pushing and tugging. The sides are flared, preventing the handrails from coming in contact with objects being towed or pushed and

also helping throw spray from the boat. The boat has a steering mechanism in which the rudder is connected rigidly to the steering lever. Equipment includes towing bits, bow and stern lights, a mounted searchlight, a fire extinguisher, anchors, life preservers, spare parts, and tools (fig. 22). It has the following characteristics:

Length, over-all	18 feet.
Width, maximum	6 feet 9 inches.
Depth, maximum	2 feet 6 inches.
Weight, including engine and accessories	1,800 pounds.
Maximum allowable load	4,000 pounds.



FIGURE 22. *Spare parts and tools of power utility boat.*

b. Engine. The boat is powered with a 57 hp. marine engine equipped with a governor that keeps it operating at a safe and economical speed and allows it to develop its full power for towing or pushing. It has the standard marine type propeller drive with forward, neutral, and reverse gears.

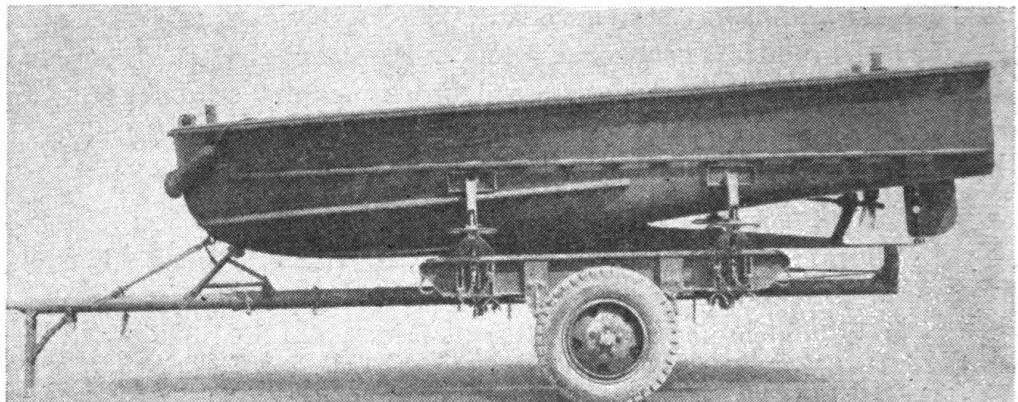


FIGURE 23. Power utility boat on two-wheel trailer.

20. TRANSPORTATION. The boat is carried on a two-wheel pole type utility trailer type IV (fig. 23) from which it can be launched directly into the water.

21. EMPLOYMENT. a. Crew. The crew consists of an operator and a bowman. Both should be well trained in operation, employment, and repair of the boat and in maintenance of the engine.

b. Construction of floating bridges. The principal use of the boat is to aid in building floating bridges.

(1) POWERING BRIDGE PARTS FOR ASSEMBLY IN BRIDGE. The most satisfactory method of controlling a ponton-bridge part with the boat is shown in figure 24. The stern steering lines run from the stern tow bits on the boat, through the rope chocks on the ends of the outer

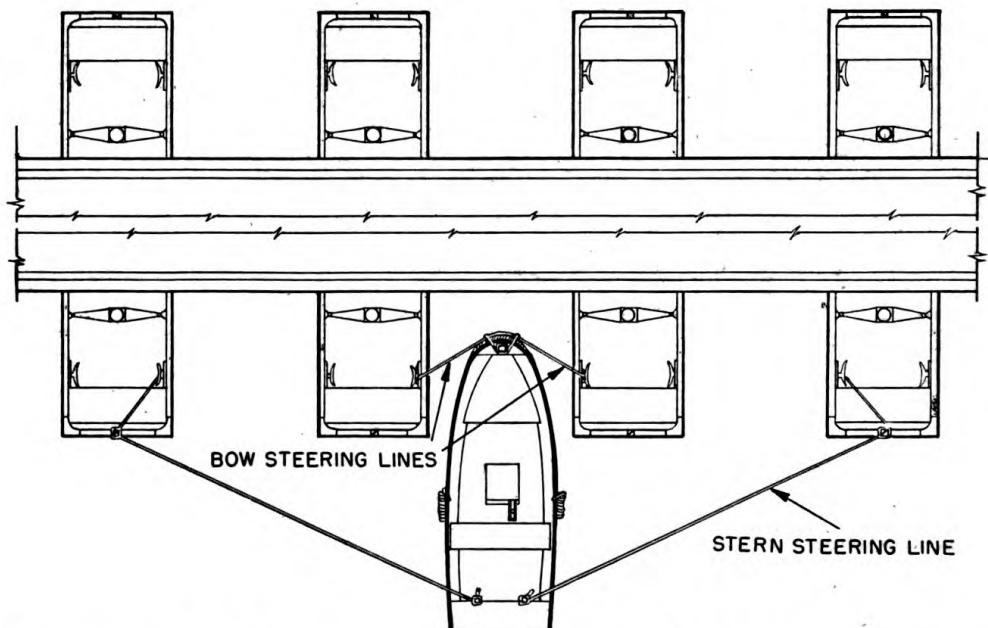


FIGURE 24. Method of control of ponton-bridge part by the power utility boat.

pontons, to the cleats on the sides of the pontons. The bow steering lines run from the bow tow bit of the boat to the cleats on the sides of the middle pontons. This type connection permits maximum control and maneuverability. A similar method of control is used for steel treadway bridge parts. It is essential to use ropes of sufficient size and in good condition.

(2) DELIVERING PONTONS FROM UNLOADING TO CONSTRUCTION SITES. The most satisfactory method is to push the ponton by attaching the boat to the side and rear as shown in figure 25. The stern steering line runs from the stern tow bit of the boat, through the rope chock on the end of the ponton, to the cleat on the side of the ponton next to the boat. The bow steering line runs from the bow tow bit of the boat to the bow capstan of the ponton. The tow line runs from the bow tow bit of the boat to the stern capstan of the ponton. A bumper is used between boat and ponton. This type connection permits maximum control and maneuverability.

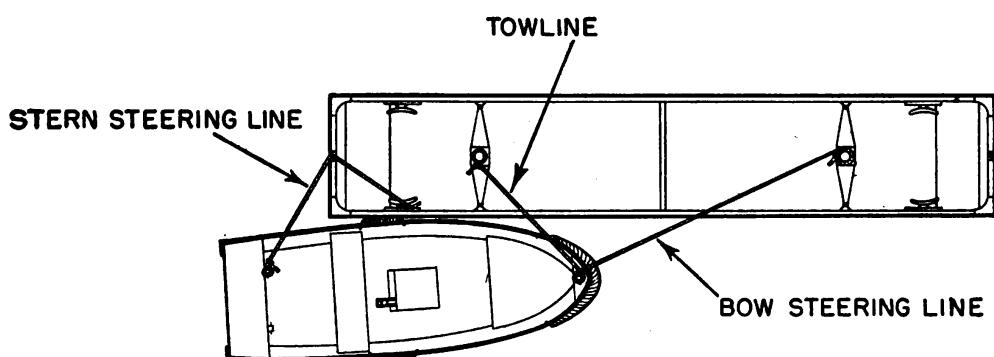


FIGURE 25. *Method of control of single ponton by power utility boat.*

(3) PLACING AND REMOVING ANCHORS. The best general method is to proceed from the bridge toward the location for the anchor, keeping the bow of the boat headed into the current. When over the spot, drop the anchor from near the bow of the boat, allowing the anchor rope to uncoil. It is important that the free end of the rope be made fast, and that the rope be so placed that it will uncoil freely. After the anchor is placed, the boat is put in reverse, run back to the bridge, and the free end of the rope is fastened to a cleat on a ponton in the bridge.

(4) DEBRIS CONTROL. The boat can be employed effectively in debris control. Large pieces of debris can be pushed to the stream banks or lifted into the boat. The boat also is useful in erecting a log boom or a cyclone fence upstream from the bridge.

c. **Passengers.** The boat may be used to ferry personnel. The maximum load is 10 fully equipped riflemen in addition to the 2-man crew.

d. **Cargo.** The boat may be used to ferry vital supplies. The maximum allowable load is 4,000 pounds.

e. Performance. The unloaded boat attains a maximum speed of 14½ miles per hour carrying its two-man crew. Its speed when pushing, towing, or ferrying varies inversely with the size of the load.

f. Other uses. It can be used to propel rafts and ferries, and to tow small barges.

22. MAINTENANCE. Proper maintenance of the power utility boat involves the following:

a. Care of hull. The hull should be kept clean and free of water at all times. It should be inspected periodically for leaks, bruises, and fractures. For repair, see chapter 5. Metal parts should be protected by paint or grease.

b. Care of engine. See TM 5-595-1.

c. Care of accessories. All accessories should be inspected periodically to see that they are in good working order. Replacements should be made as required.

CHAPTER 5

REPAIR OF PLYWOOD BOATS

23. GENERAL. Two types of repair can be made on plywood boats: *hasty repairs*, which can be made in a few minutes and with a small amount of material; and *permanent repairs*, which require considerable time and more elaborate materials.

24. HASTY REPAIRS. a. Bullet holes. When a bullet strikes a plywood boat it leaves a hole approximately the diameter of a pencil. When practicable, a plug is inserted from the side hit by the bullet. There are two types of plug.

(1) **RAG PLUG** (fig. 26①). Stuff a rag, handkerchief, or similar material into the hole with a stick, pocket knife, or screw driver.

(2) **PEG PLUG** (fig. 26②). Whittle a wooden plug to the approximate shape of the hole, and wedge it in.

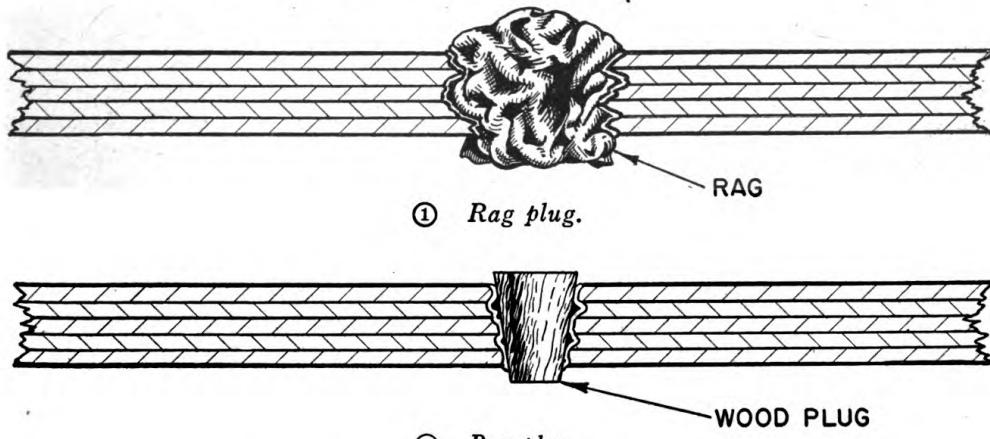
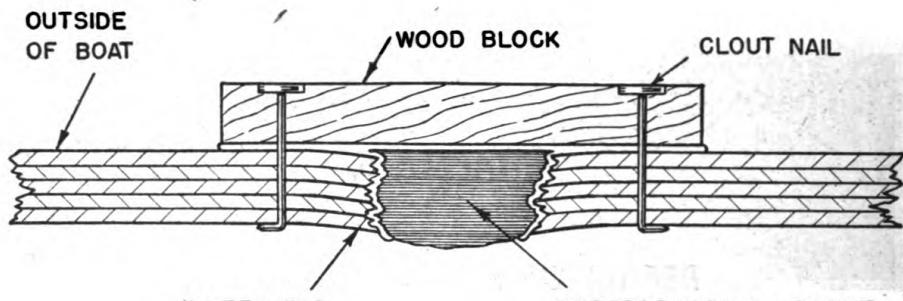
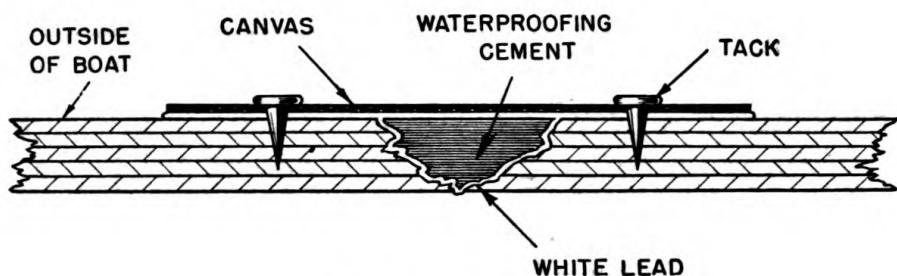


FIGURE 26. *Hasty patching of bullet hole.*

b. Large punctures. Large punctures or dents in plywood usually are caused by bumping into rocks, tree roots, and similar obstacles. To make a hasty repair, press the damaged wood fibers into place, line the



① *Wood patch.*



② *Canvas patch.*

FIGURE 27. *Hasty patching of large puncture.*

hole with white lead, and fill it with waterproofing cement. Apply one of the following patches:

- (1) **WOOD PATCH** (fig. 27①). Nail a small piece of wood over the hole. It is best to use clout nails large enough to penetrate both the wood patch and the material of boat. The nails then can be clinched to rivet the patch securely in place.
- (2) **CANVAS PATCH** (fig. 27②). Tack a piece of heavy canvas over the hole. This will keep out most of the water, but is only a temporary repair.

25. PERMANENT REPAIRS. a. Methods. The two general methods for the permanent repair of plywood are as follows:

- (1) **HOLES LESS THAN 12 INCHES SQUARE.** Apply a piece of metal over the damaged place.
- (2) **HOLES GREATER THAN 12 INCHES SQUARE.** Insert a new piece of plywood.

b. Metal patch. Metal patches can be used to repair holes in plywood boats or pontons by the following methods:

- (1) **METAL-DISK PATCH.** Patch a small hole by using two small disks of metal about 2 inches in diameter. Drill eight equally spaced holes $\frac{1}{4}$ inch from the edge of the disks. After the hole in the plywood



FIGURE 28. *Filling hole with white lead.*

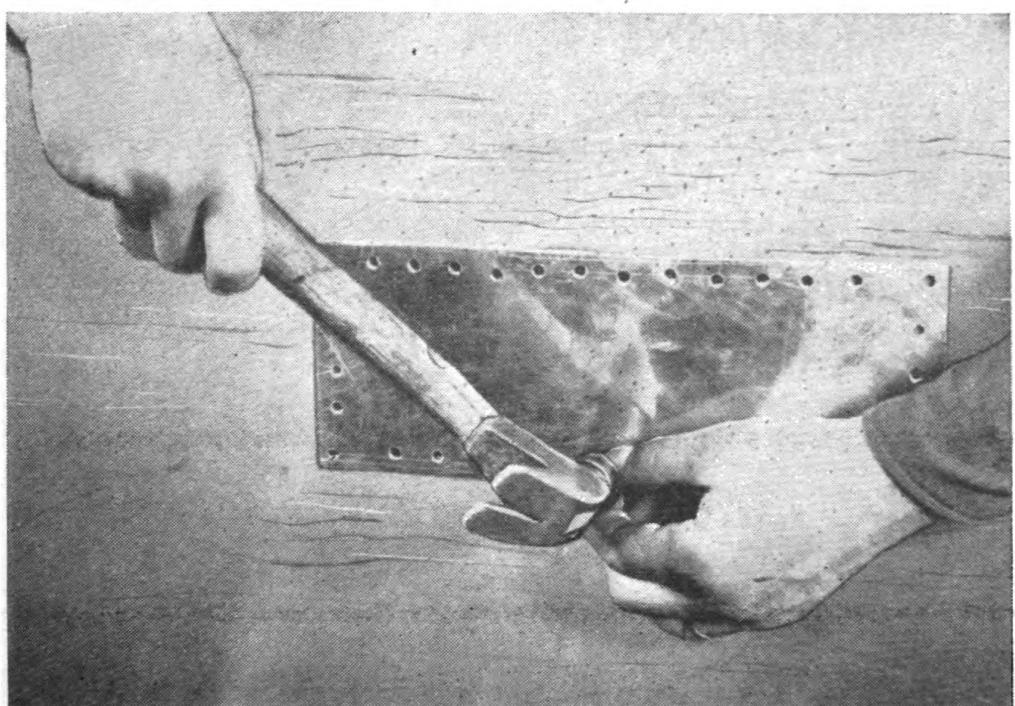


FIGURE 29. *Driving rivet into metal-plate patch.*

has been filled with a white lead liner and a waterproofing cement filler, apply one disk on the inside and one on the outside, and rivet.

(2) METAL-PLATE PATCH ON FLAT SURFACE. Smooth off the plywood around the hole on both inside and outside so the plates fit the surface evenly. If considerable wood is removed, line the hole with a marine type mastic such as white lead (fig. 28), and fill it with waterproofing cement. After the lead and cement have hardened, again smooth off the surface. From 16-gauge sheet metal cut two metal patches at least 2 inches larger than the dimensions of the damaged plywood. Around the outside plate, drill holes about 1 inch apart and $\frac{1}{2}$ inch from the edges. Apply a coat of heavy paint or white lead under each piece of metal, to insure water-tightness. After the outside plate has been placed over the damaged plywood, use it as a pattern to drill the inside plate. Drill two holes through the plywood and the inside plate at diagonal corners. Insert (fig. 29) and clinch rivets. Drill the remaining holes, and insert and clinch the remaining rivets.

(3) METAL-PLATE PATCH ON CURVED OR ANGULAR SURFACE (figs. 30 and 31). Repairing a curved or angular surface is similar to repairing a flat surface. The patch is shaped to fit accurately the curve of the damaged place. The hole is smoothed off and filled as in (2) above. The metal patches can be made of 16-gauge sheet aluminum or of 18-gauge galvanized sheet iron. Holes are drilled as in (2) above. The outside

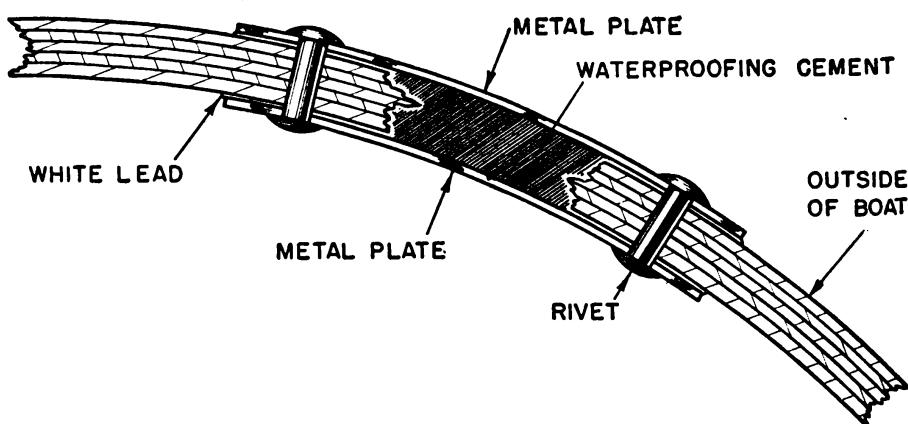


FIGURE 30. *Metal-plate patch on curved surface.*

plate is riveted first. Using the outside plate as a pattern, the inside plate is placed, and the diagonal corners are drilled and riveted. The remaining holes are riveted and the patch is waterproofed.

c. **Inserted plywood patch.** The most practical way to repair larger holes and breaks is to insert a new piece of plywood. Depending upon the

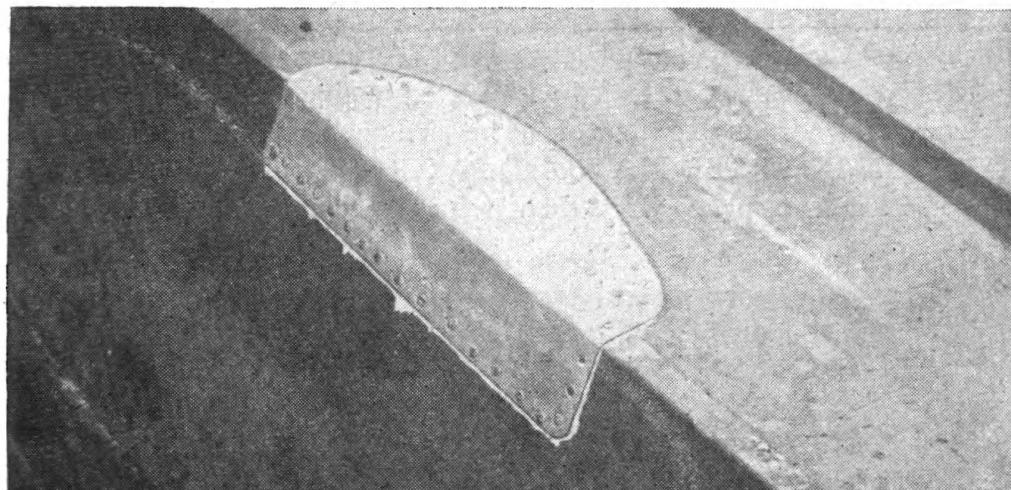
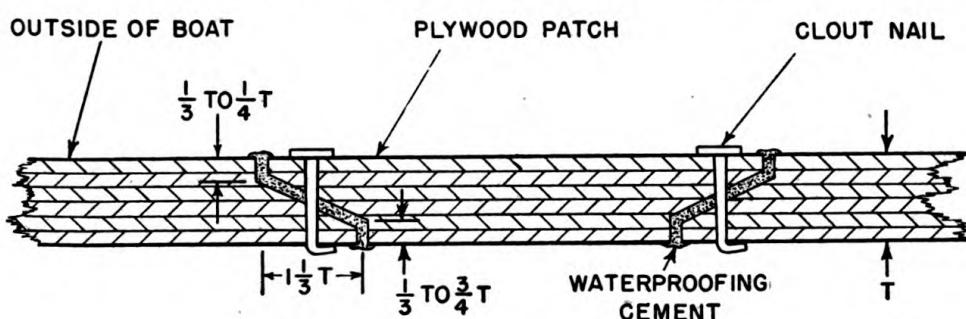
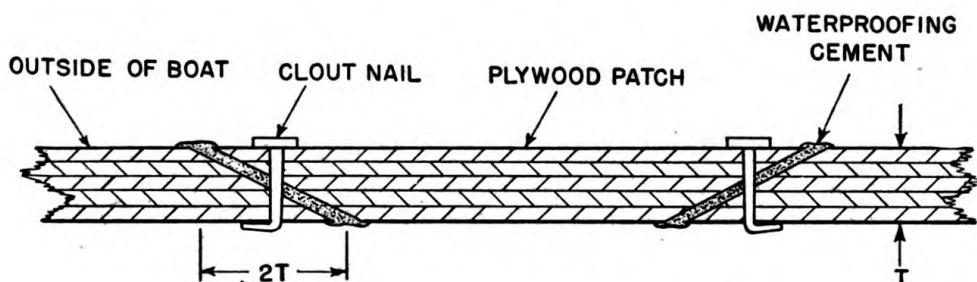


FIGURE 31. Metal-plate patch on angular surface.



① Thick inserted plywood patch.



NOTE: T = THICKNESS OF PLYWOOD

② Thin inserted plywood patch.

FIGURE 32.

nature and the position of the hole, one of the following methods can be used:

(1) THICK INSERTED PLYWOOD PATCH (fig. 32①). For holes in plywood $\frac{1}{2}$ -inch or more thick, as at the sterns of most plywood boats, the patch is inserted as follows: cut away wood splinters; square hole as in figure 33, and chisel out one-quarter to one-third the thickness of the plywood, beveling portions between straight cuts as in figure 32① (length

of bevel should be about $1\frac{1}{3}$ times thickness of plywood); insert a piece of plywood the size of the hole (fig. 34). To insure watertightness, new patch is glued in place or sealed with waterproofing cement. Clout nails then are driven through centers of the beveled portions, and clinched.

(2) THIN INSERTED PLYWOOD PATCH (fig. 32②). This method is used for holes in plywood less than $\frac{1}{2}$ inch thick, as at the sides of boats.



FIGURE 33. *Squaring hole.*

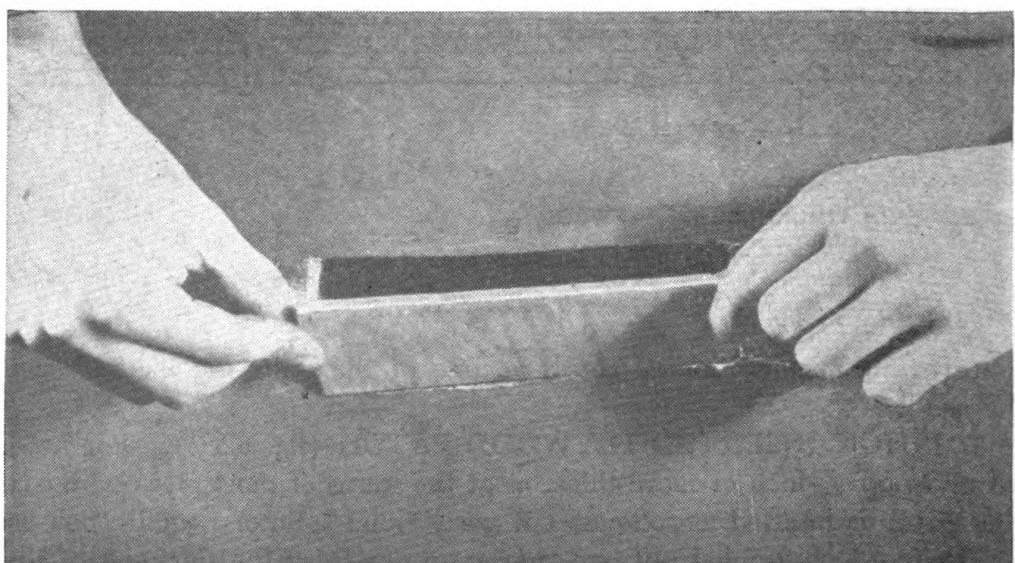


FIGURE 34. *Inserting piece of plywood.*

The patch is made as in (1) above, except the entire cut is beveled. The bevel should be twice the length of the thickness of the plywood.

(3) METAL-REINFORCED, INSERTED PLYWOOD PATCH (fig. 35). This method is particularly useful for repairing sides of plywood boats where a patch stronger than those described in (1) and (2) above is desired. Cut away rough fibers, prepare holes as in (1) or (2) above, insert plywood patch, and apply waterproofing cement over it. Next, cut a square metal plate, using 16-gauge aluminum or 18-gauge galvanized sheet iron, about 2 inches larger than the hole it is to cover. Drill holes in the metal plate about 1 inch apart and 1 inch from edges. Apply plate, screw or rivet it in place, and clinch rivets.

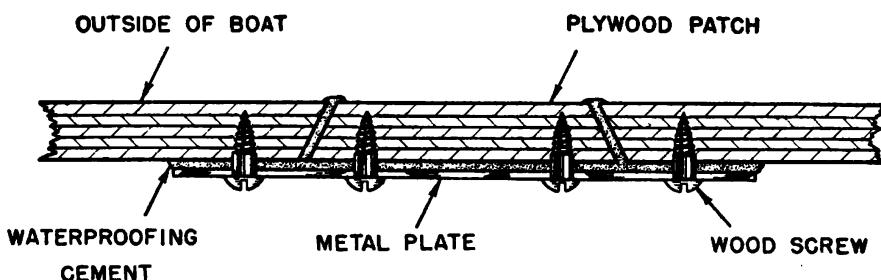
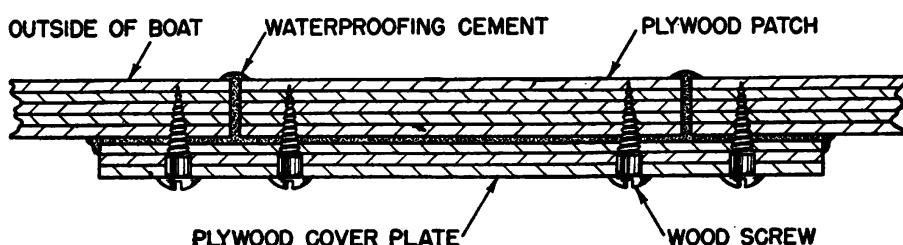


FIGURE 35. *Metal-reinforced, inserted plywood patch.*

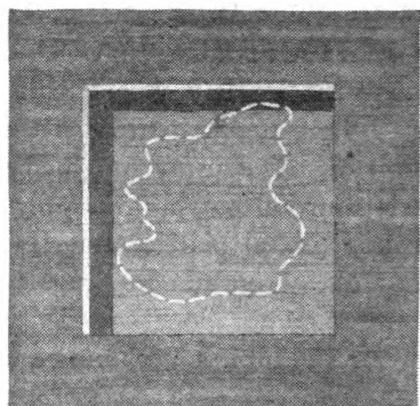


• FIGURE 36. *Wood-reinforced, inserted plywood patch.*

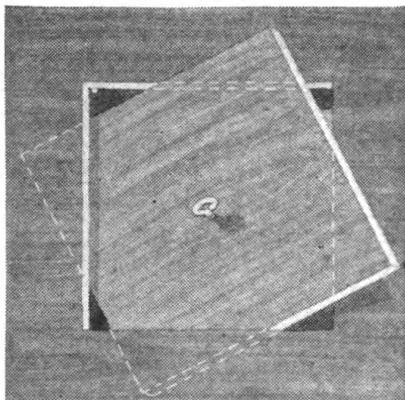
(4) WOOD-REINFORCED, INSERTED PLYWOOD PATCH (fig. 36). This method is particularly useful for repairing holes in bottoms of plywood boats. To repair the bottom of either an M1 or M2 assault boat, first remove floor boards around hole. Turn boat upside down. Cut away rough edges, and square hole. Make patch from a piece of plywood the same thickness as the original material, cutting it to fit prepared hole. Apply waterproofing cement to edges of hole, and insert plug. Turn boat right side up. Cut a cover plate of plywood about $\frac{3}{4}$ inch larger than plug, apply waterproofing cement to its underside, and screw it into place on inside of the boat. One row of screws passes through bottom of the boat and the other through plug.



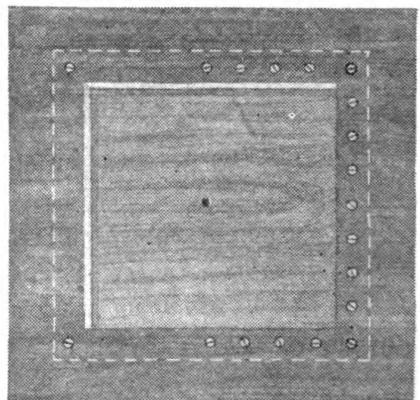
①



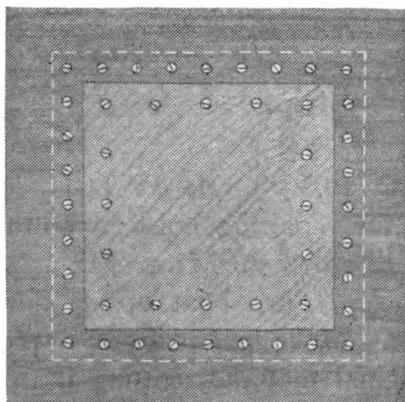
②



③



④



⑤

- ① ORIGINAL HOLE
- ② HOLE SQUARED
- ③ COVER PLATE BEING INSERTED WITH EYE SCREW
- ④ COVER PLATE PARTIALLY FASTENED IN PLACE WITH WOOD SCREWS
- ⑤ INSERTED PLYWOOD PATCH IN PLACE

FIGURE 37. *Steps in repairing hole in bottom of storm boat with a wood-reinforced plywood patch.*

d. The storm boat has a double bottom. Rather than take out the false bottom it is simpler to repair a hole in the bottom of this boat (fig. 37①) as follows: turn boat upside down; cut away rough edges and square hole (fig. 37②) so a cover plate can be inserted; prepare cover plate as above, and attach an eye-screw to its center; apply waterproofing cement to inner side of cover plate; insert cover plate through hole (fig. 37③), and with the eye-screw maneuver it into proper position; holding it in position by eye-screw, screw cover plate to bottom of boat (fig. 37④); remove eye-screw, apply waterproofing cement to edges of original hole, and insert a plywood plug; screw inserted plywood plug to cover plate (fig. 37⑤).

26. PAINTING. After any permanent patch is applied to a plywood boat, it should be painted with at least two coats of lusterless, olive-drab paint to protect the repair and to insure the boat is watertight.

27. REPAIR KIT. A repair kit (figs. 38 and 39) is issued to all units which have plywood boats. It contains plywood, sheet metal, cotton duck, rivets, screws, nails, and tools necessary to make repairs.

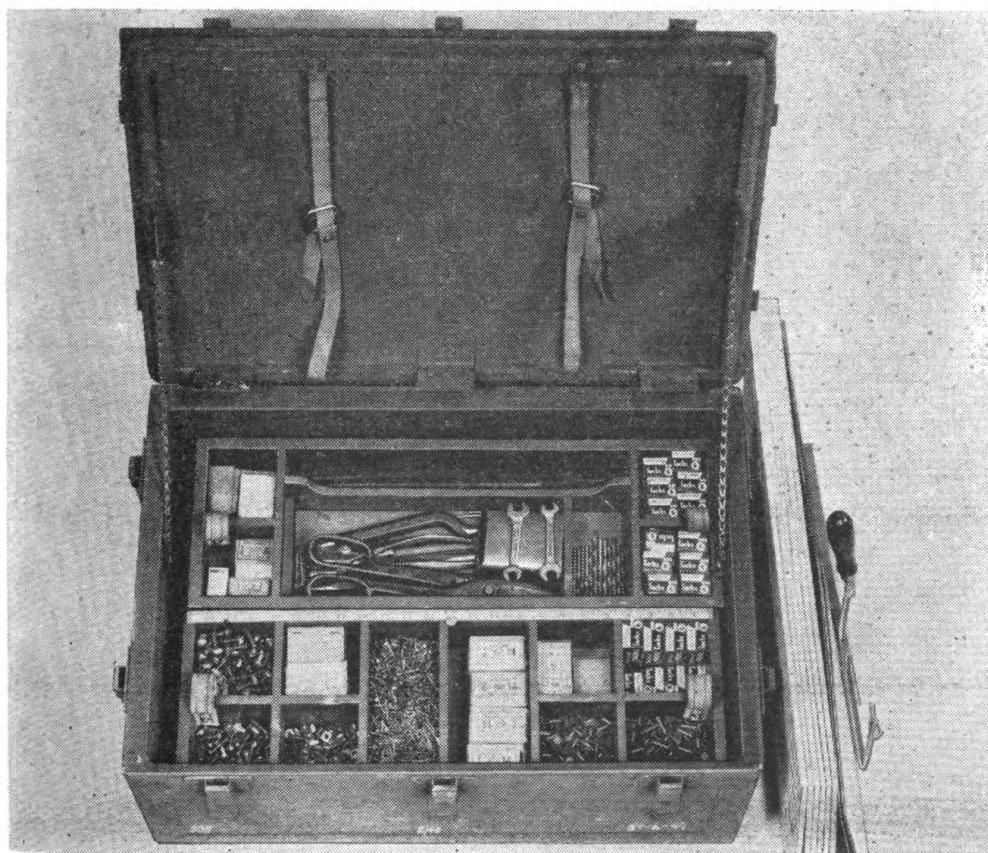


FIGURE 38. *Plywood-repair kit.*

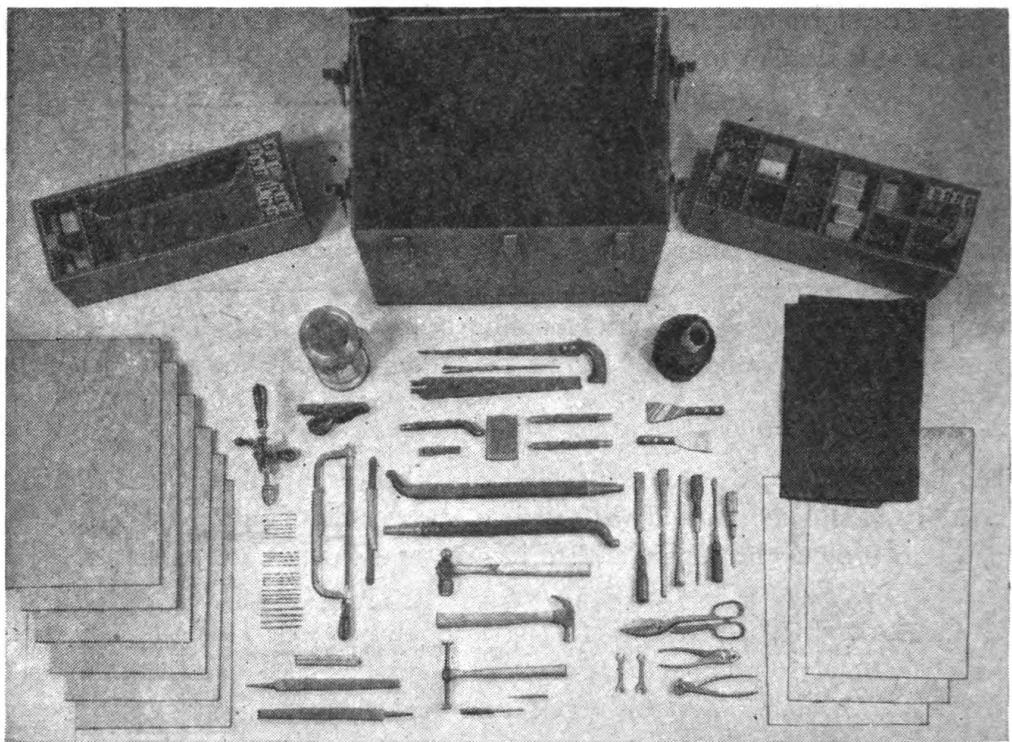


FIGURE 39. *Plywood-repair kit with tools laid out.*

CHAPTER 6

PNEUMATIC RECONNAISSANCE BOATS AND 6-TON PNEUMATIC FLOAT

Section I

Six-Man Pneumatic Reconnaissance Boat

28. DESCRIPTION. The six-man pneumatic reconnaissance boat (fig. 40) is 9 feet 6 inches long by 5 feet wide. It tapers to a point at the bow and tapers slightly to a blunt end at the stern. It is formed of rubberized fabric tubing, 16 inches in diameter, which is divided by bulkheads into four compartments. It has a flooring of rubberized fabric. A life line extends around the outside. There are two inflatable seats, 20

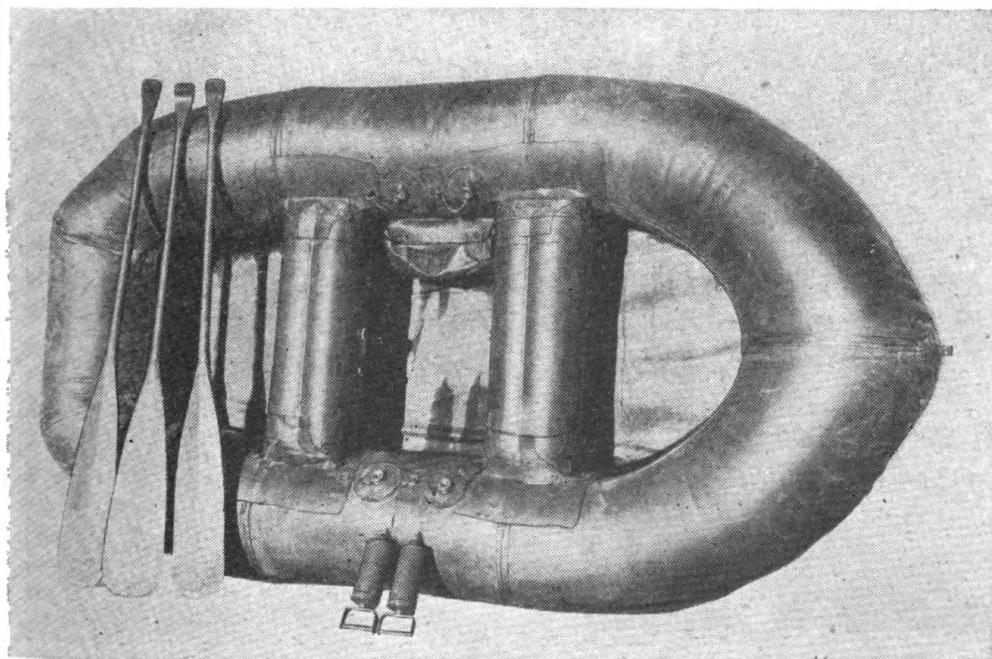


FIGURE 40. Six-man pneumatic reconnaissance boat.



① Carrying three men on reconnaissance.



② Carrying six men in river crossing.

FIGURE 41. Employment of pneumatic reconnaissance boat.

inches long, 10 inches wide, and 6 inches deep. Inside the boat is a pocket which contains an emergency repair kit and two small hand pumps. The boat weighs approximately 55 pounds, and has a maximum displacement of 1,600 pounds. It will carry six men (fig. 41②). Three paddles are issued with each boat. Deflated, the boat is folded and packed into a carrying case 3 feet long and 18 inches in diameter.

29. INFLATION AND DEFLATION. Hand pumps inflate the reconnaissance boat. Inflation by an air compressor is not recommended. The boat can be inflated in 10 minutes by use of two hand pumps. In an emergency the boat can be inflated by mouth. Air pressure should be sufficient to round out the air chambers, which should be firm but not hard, and should yield to pressure applied by the heel of the hand.

30. METHOD OF EMPLOYMENT. The six-man pneumatic boat is used primarily for reconnaissance work (fig. 41①) such as measuring width and depth of streams, determining types of river bottom, and inspecting bank conditions for suitability of bridges and ferry sites. It may also be used to supplement assault boats in river crossings (fig. 41②) and for general utility work in bridge construction. Inflated, it can be carried by two men.

31. STORAGE AND REPAIR. The directions in paragraph 40 for the 6-ton float also apply to the pneumatic reconnaissance boat. The emergency repair kit issued with the reconnaissance boat is similar to that issued with the 6-ton float.

Section II

Two-Man Canvas Pneumatic Reconnaissance Boat

32. DESCRIPTION. The two-man canvas pneumatic reconnaissance boat (fig. 42) is 7 feet 9 inches long by 3 feet 5 inches wide. Ends of the boat are pointed and raked upward. The boat is formed of canvas fabric tubing 14 inches in diameter, which is divided by bulkheads into twelve compartments. It obtains its buoyancy from synthetic plastic bladders inserted in each bulkhead. The boat has a double canvas bottom. These two bottoms are separated by a sheet of the same material from which the bladders are made. The outer bottom has numerous holes which permit water to flow in to form a keel, the plastic sheet preventing the water from passing through the inner canvas bottom. A life line encircles the boat. Inside the boat is a pocket which contains an emergency repair kit. The boat weighs approximately 25 pounds and has a displacement of about 500 pounds. It will carry two men in currents up to 7 to 8 feet per second and three men in currents up to 4 to 5 feet per second.

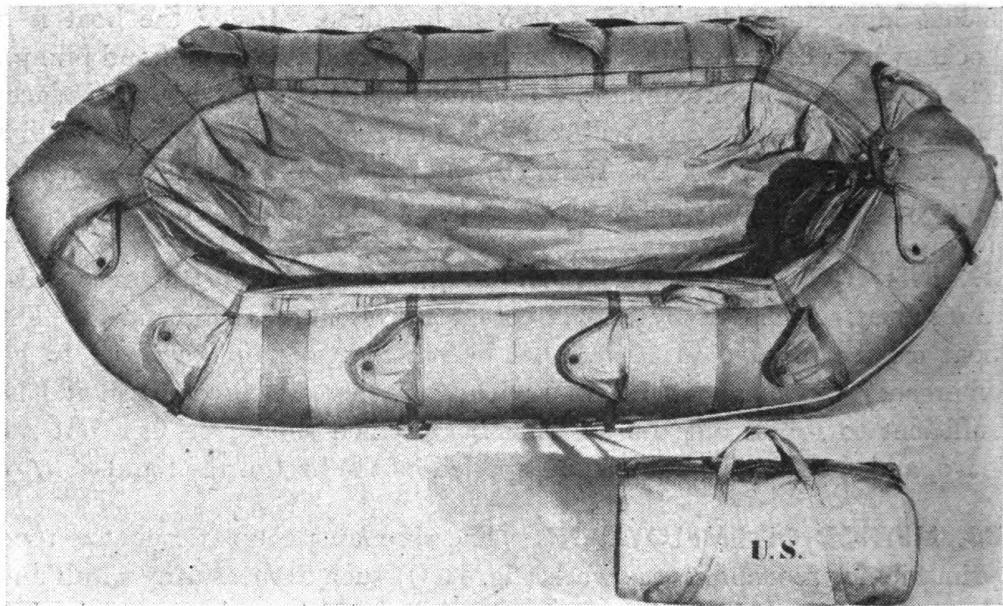


FIGURE 42. *Two-man canvas pneumatic reconnaissance boat.*

Two folding paddles are issued with each boat. Deflated, the boat is rolled and packed in a carrying case (fig. 42) 1 foot 9 inches long and 9 inches in diameter.

33. INFLATION AND DEFLATION. **a.** The bladders are inflated by mouth through inflation tubes made of the same material as the bladders. After inflation the tube is bent over and fastened by a canvas strap and metal snap type fastener. The tube then is covered by a small canvas flap, also held down by a snap type fastener.

- b.** All twelve bladders can be breath-inflated by—
(1) One man in 12 minutes.
(2) Two men in 5½ minutes.
(3) Three men in 3½ minutes.

c. The bladders should be firm but not hard and should yield to pressure applied by the heel of the hand. If 6 of the 12 compartments are deflated, the boat still floats with 3 men in it; with 8 deflated, it will float with 2 men; and with 10 deflated, it will float with 1 man.

34. METHODS OF EMPLOYMENT. See paragraph 30. Figure 43① shows the boat carrying two men and a caliber .30 heavy machine gun and ammunition. Figure 43② shows the canvas reconnaissance boat carrying three riflemen.

35. REPAIR KIT. Each boat has an emergency repair kit consisting of spare bladders, tape, thread, canvas, needles, scissors, beeswax, and a book of instructions.



① *Carrying three riflemen in river crossing.*



② *Carrying two men and a caliber .30 heavy machine gun and ammunition.*

FIGURE 43. *Employment of canvas pneumatic reconnaissance boat.*

Section III

Six-ton Pneumatic Float

36. DESCRIPTION. a. The 6-ton pneumatic float (figs. 44 and 45) is 20 feet long, 6 feet wide, and 2 feet deep. It is made of rubberized fabric

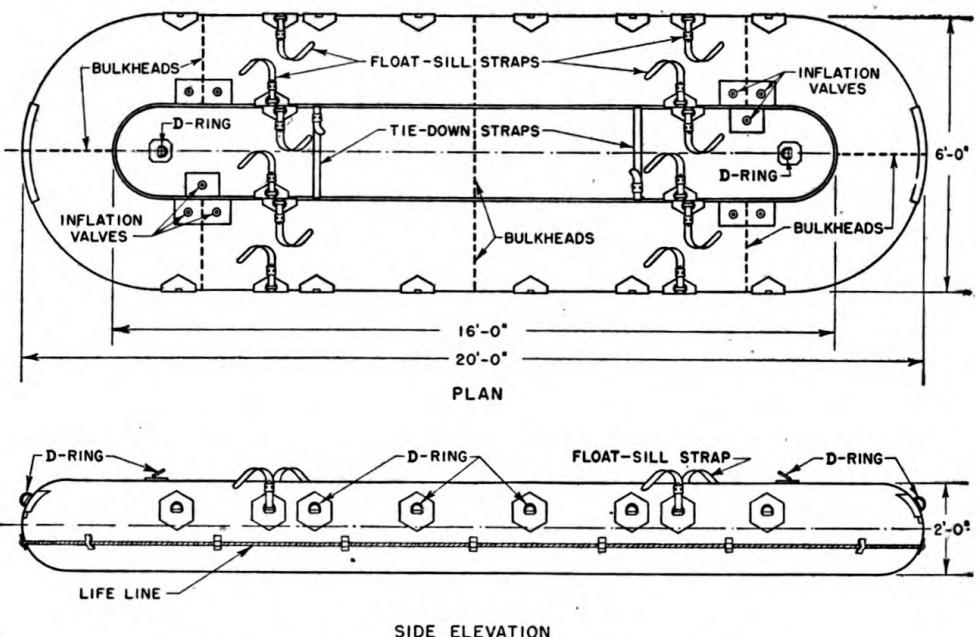


FIGURE 44. *Plan and elevation of 6-ton float.*

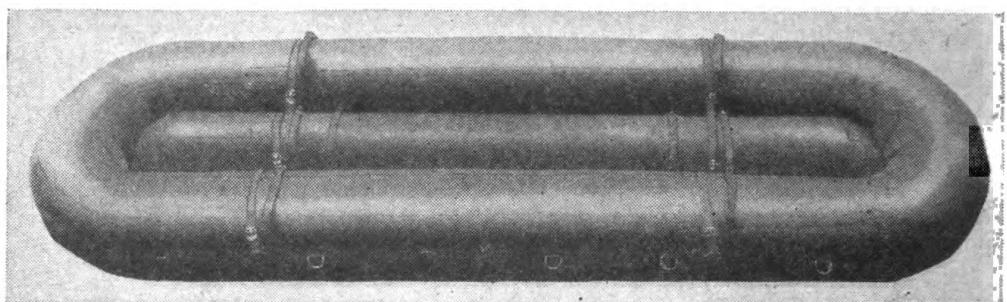


FIGURE 45. *Six-ton pneumatic float.*

and consists of an outer tube, a floor, and a removable center tube. Each tube is 24 inches in diameter.

- (1) The outer tube is divided by bulkheads into eight compartments, each with a separate inflation valve. Straps on the outer tube are used to secure a superstructure to the float when constructing expedient rafts or bridges.
 - (2) The removable center tube is divided into two compartments. Tie-down straps hold it in place. It increases the rigidity of the float and maintains buoyancy when the float is submerged. Normally it is removed when the float is used as a personnel carrier.
 - (3) A life line extends around the outside of the float. It is *not* used for carrying. D-rings are attached to the float for carrying and lashing purposes.
- b. The float weighs approximately 375 pounds and has a maximum displacement of 12,000 pounds. It is carried folded in a canvas case 3 feet square by 18 inches deep. Included in each case is an emergency repair kit. Seven paddles in a canvas case are issued with each float.

37. INFLATION AND DEFLECTION. **a.** Pneumatic floats must be inflated with care. The air used should be free of oil. The float may be inflated in approximately 3 minutes by using a four-hose inflation-deflation manifold with the standard air compressor.

b. The working pressure in the float should not exceed $1\frac{1}{2}$ pounds per square inch; at this pressure the air chambers are firm but not hard, and yield to pressure applied by the heel of the hand. Additional pressure adds nothing to buoyancy and will damage the float. Changes in temperature should be anticipated. Floats inflated to proper pressure will become over-inflated if aid is not released as the temperature rises. Air must be added as the temperature drops. Air pressure should be checked regularly.

c. Floats are deflated by removing valve caps and allowing air to escape. The remaining air should be drawn out with the inflation-deflation manifold to make the float easier to pack in small space.

38. CARRYING FLOAT. Inflated floats should be carried, not dragged, as dragging tears the fabric.

39. METHODS OF EMPLOYMENT. **a. Personnel carrier.** The float may be employed either as a reconnaissance boat or as an assault boat in a river crossing (fig. 46). As an assault boat, it is too vulnerable to small-arms fire to be used in the first wave. When the float is used to carry personnel or equipment, the center tube is removed. Laying planks on the flooring prevents puncturing the fabric. The float will accommodate 15 men comfortably, or 30 when crowded. The men straddle the outer tube and propel the float with paddles. If enough paddles are available, as many as 15 may be used.



FIGURE 46. Six-ton pneumatic float employed as an assault boat.

b. Expedient rafts. (1) Rafts may be assembled of pneumatic floats and extra plywood treadways, siderails, and siderail clamps from infantry-support-raft equipment (see ch. 7). Siderails, used as float sills, are laid along the outer tubes of the floats and strapped in place. The treadways are laid across the float sills and lashed to the D-rings on the sides of the floats. Siderails are clamped in place on the inside edges of the treadways.

(2) If standard equipment is not available a superstructure may be improvised from local materials. Planks may be used as float sills; timbers, 4 by 6 inches or larger, telephone poles, or logs may be used as stringers; and planks at least 2 inches thick will serve as flooring. Lashings are used to tie parts of the superstructure together and to hold it in place on the floats.

(3) An expedient raft can be constructed with center tubes from the floats and chess or similar planks. (See fig. 47.)

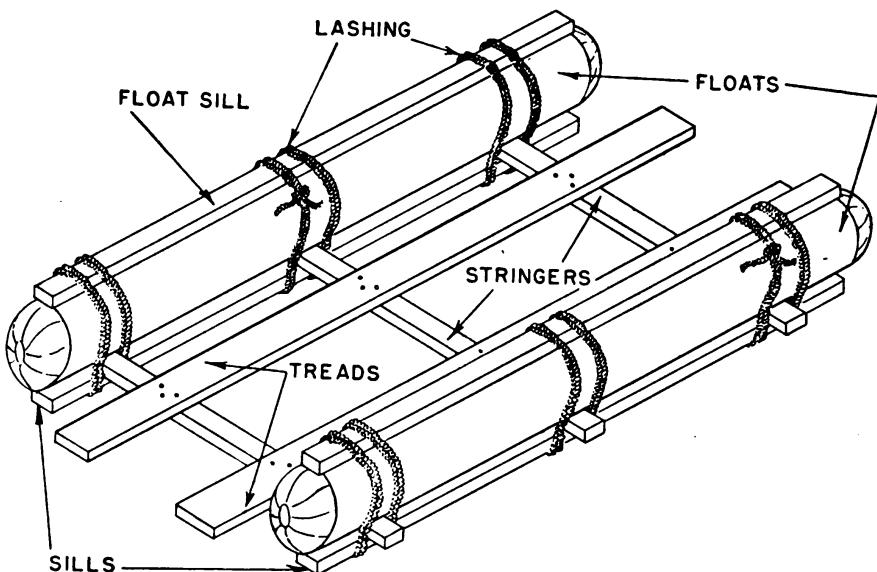


FIGURE 47. *Expedient raft employing removable center tubes of 6-ton float.*

40. STORAGE AND REPAIR. a. Storage. Because heat and sunlight cause deterioration of rubber, pneumatic floats should be stored in a dry, cool, dark place. They should be thoroughly cleaned and dried before storing, and kept off the ground on planks to prevent mildew. When floats are stored on a beach they should be stacked upside down to prevent them becoming filled with water. When they are stored deflated all valve caps should be on tight to keep out moisture.

b. Repair. (1) **EMERGENCY REPAIR KIT.** Packed in each float-carrying case is an emergency repair kit containing pieces of rubberized fabric, a metal scratcher, a bottle of rubber cement, valve caps and washers, a hand roller, a pair of scissors, and wooden plugs.

(2) REPAIR OF FLOATS. (a) *Cement repairs.* Small leaks can be located by inflating the float and covering the outside with thick soap-suds. After the leak is located the surface around the hole is roughened lightly with the scratcher, washed with benzine, naphtha, or clear gasoline, and allowed to dry. At least two coats of heavy cement (three parts cement to one part benzine or gasoline) are applied to the area. While this is drying a piece of rubberized fabric is cut to size and prepared in the same manner. The patch then is applied over the hole and rolled or pressed down firmly. To repair large tears it is necessary first to prepare the inside surface and to place a patch inside of the tubes; where necessary, the hole may be enlarged to permit this. After the inside patch has been placed and allowed to dry, an outside patch is applied as previously described.

(b) *Repair with wooden plugs.* Temporary repair of small leaks can be made by using the wooden plugs in the repair kit. They are inserted into the hole and twisted tight.

(c) For a more detailed discussion of float repairs, see TM 5-275.

CHAPTER 7

INFANTRY-SUPPORT RAFT NO. 1

Section I

General

41. PURPOSE. **a.** The infantry-support raft is used to ferry combat vehicles. Construction of rafts is initiated during the second phase of a river crossing.

b. The standard raft requires six assault boats M2, connected in pairs, stern to stern, to form three assault-boat pontons. Reinforced rafts can be built by adding additional assault-boat pontons, or 6-ton pneumatic floats (see sec. VI).

c. The assault boats used to construct the rafts may be used to cross the initial waves of the infantry covering force. As soon as these boats become available and the situation permits, rafts are constructed and put into operation.

42. CAPACITY. Table I gives the posted capacity in various stream velocities of the standard three-assault-boat ponton raft and of rafts reinforced with additional assault-boat pontons and 6-ton pneumatic floats (see sec. VI). It also lists typical vehicles and gives the conditions under which they may cross. Any combination of individual vehicles may be carried if their total weight does not exceed the posted capacity and their total length is less than the supported length of the treadways. For combinations of individual vehicles where the total weight exceeds the posted capacity of the raft, see table I.

VEHICLES	WEIGHT CLASS - TONS	INFANTRY-SUPPORT RAFT										
		NORMAL		REINFORCED								
3 - Ponton 3 - Treadway		5 - Ponton 4 - Treadway		3 - Ponton 2 - Float 4 - Treadway		7 - Ponton 5 - Treadway		4 - Ponton 3 - Float 5 - Treadway				
CAPACITY IN TONS POSTED ON RAFT												
4	8	8	5	10	13	5	10	13	8	13	13	
MAXIMUM STREAM VELOCITY IN FEET PER SECOND ①												
7	5	3	7	5	3	7	5	3	7	5	3	
Truck, 1/4-T	2											
Truck, 1/2-T, all types	3											
Truck, 3/4-T, all types	4											
Truck, 1/2-T, w/1-T tlr.	4											
Car, scout, M3A1	5	■■■										
Truck, 1 1/2-T, all types	5	■■■										
Truck, 1 1/2-T, w/1-T tlr.	6	■■■	■■■									
Truck, 1 1/2-T, w/105-mm How.	6	■■■	■■■									
Truck, 1 1/2-T, w/camera tlr.	8	■■■	■■■	■■■								
Compressor, air, mtzd. 6 x 6 (Engr.)	7	■■■	■■■	■■■								
Water purification unit, mobile (Engr.)	8	■■■	■■■	■■■								
Truck, 2 1/2-T, all types	8	■■■	■■■	■■■								
Car, armored, light, M8	8	■■■	■■■	■■■								
Car, half-track, M2	9	■■■	■■■	■■■								
Truck, 2 1/2-T, w/1-T tlr.	9	■■■	■■■	■■■								
Truck, 2 1/2-T, w/105-mm How.	9	■■■	■■■	■■■								
Sterilizer unit (Medical)	10	■■■	■■■	■■■								
Tractor, D-4, w/dozer	7	③	③	③	③	③	③	③	③	③	③	
Grader, road, mtzd. (Engr.)	11	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Car, half-truck, M2 and truck, 1/4-T	11	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Truck, 4-T, wrecker	11	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Truck, 2 1/2-T, w/155-mm How., carr. M1	11	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Crane, trk.-mtzd. (Engr.)	12	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Tank, light, M2A4	12	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Truck, 4-T, cargo	13	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Truck, 4-T, ponton	13	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Crane, trk.-mtzd., w/crane atchmmts. tlr.	15	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
2 Trucks, 2 1/2-T	16	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Truck, 4-T, w/155-mm How., carr. M1	16	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
2 Cars, half-track, M2	18	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Truck, 4-T and truck, 2 1/2-T	21	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
Tank, light, M3	14	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
2 Trucks, 4-T	26	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	■■■	
NOTES												
① Stream velocity relative to raft.												
② Caution on rafts means vehicle must be placed as far as possible downstream on raft deck.												
③ Will cross only if treadways are placed closer together.												
④ Deck length insufficient.												
⑤ Unsafe because treadway joints are overstressed.												

TABLE I. Capacity of infantry-support rafts. Posted capacity of rafts may be exceeded if this chart indicates vehicles can cross.

43. COMPOSITION AND ASSIGNMENT OF RAFT SET.**a. Composition.**

Table II gives the component parts of the infantry-support raft set No. 1.

TABLE II. *Infantry-support raft set No. 1*

Article	Quantity
Assault boat M2, complete with connecting pin.....	6
Siderail, 4 by 6 inches by 12 feet (4 spares).....	8
Clamp, siderail (2 spares).....	14
Paddle, assault-boat, with carrying case (9 per case).....	54
Pin, assault-boat connecting (spares).....	2
Pin, treadway connecting (spares).....	2
Rope, manila, $\frac{1}{2}$ -inch, 50-foot (guy line).....	4
Treadway, plywood, complete with two connecting pins and two ramp side connectors.....	8

b. Assignment. See appropriate Tables of Equipment and FM 5-35.

44. WORKING PARTY AND TIME REQUIRED. **a.** The raft normally is constructed by an engineer platoon. For organization of working party see section III.

b. Table III gives estimated times required to construct the standard infantry-support raft and various types of reinforced rafts (see sec. VI).

TABLE III. *Estimated construction times for infantry-support rafts*

Type of raft	Time in minutes ¹	
	Staff-planning purposes ²	Training purposes ³
Three-assault-boat ponton.....	10	5
Five-assault-boat ponton.....	15	8
Seven-assault-boat ponton.....	20	10
Three-assault-boat ponton, reinforced with two 6-ton floats.....	25	13
Five-assault-boat ponton, reinforced with three 6-ton floats.....	30	15

¹ Times given are for equipment stacked at site. They do not include preparation of approach roads. They are for daylight construction; for blackout, increase time 50 percent.

² Staff-planning times allow time for unpredictable delays usually encountered in tactical constructions.

³ Training times assume trained personnel, favorable weather and site conditions, and no delays.

Section II

Description of Equipage

45. ASSAULT BOAT. The assault boat M2 is described in paragraph 5.

46. PLYWOOD TREADWAY. **a.** A plywood treadway (fig. 48) has an over-all length of 14 feet, a depth of 7 inches, and a width of 3 feet 1 inch.

The covered treadway length is 12 feet. Each treadway has two steel connecting pins which when not in use are held in place by connecting pin locks in the sides of the treadway. A flexible joint is made by engaging the treadway fingers and inserting a connecting pin through the outer sets of holes of two treadways. A rigid joint is made by interlocking the fingers of two treadways and inserting two connecting pins, one through each treadway. Two pins must be used with each fixed joint to prevent damaging treadways. The traffic-bearing surface of the treadway is $\frac{3}{4}$ -inch plywood and the bottom is $\frac{1}{2}$ -inch plywood. These surfaces are painted olive drab.

b. Two ramp side connectors are issued with each plywood treadway. They are 8-inch I-beams, 4 inches long. They are inserted in triple-deck rafts (par. 92b) and bridges (par. 81a(2)) between each outer treadway and the middle treadway. Their use enables the middle treadway to support part of a load the wheels of which rest on the outer treadways.

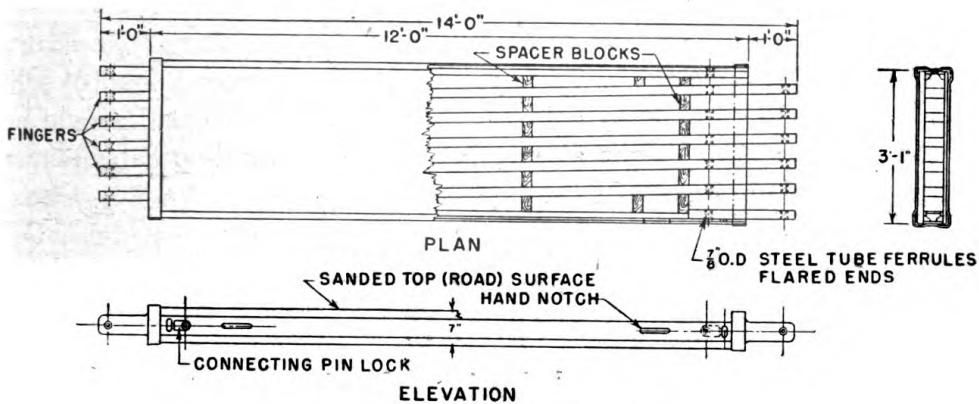


FIGURE 48. *Plywood treadway.*

47. TREADWAY-CONNECTING PIN. Two treadway-connecting pins, included as a part of each plywood treadway, are held in place in the treadway by connecting pin spring locks. The pin is L-shaped and has a 5-inch handle. It is 2 feet $11\frac{1}{2}$ inches long, $\frac{5}{8}$ inch in diameter, and is made of corrosion-resisting steel.

48. SIDERAIS. Four siderails strengthen the raft and prevent vehicles from leaving the treadways. The siderails are timbers 4 by 6 inches by 12 feet. In constructing a raft the siderails are placed along the inside edges of the plywood treadways and are clamped by siderail clamps to the under edge of the assault-boat ponton gunwales. (See fig. 49.)

49. CLAMPS. Twelve clamps are used in each raft to hold together the siderails, plywood treadways, and assault-boat pontons. The clamp, identical with the siderail clamp used with the 10-ton ponton equipage, weighs about 10 pounds.

50. GUY LINES. Four guy lines are used to align the raft during construction and to hold it while loading and unloading vehicles. Each raft has 200 feet of $\frac{1}{2}$ -inch manila rope for this purpose.

51. OUTBOARD MOTORS. Twenty-two-horsepower motors are not included in the infantry-support raft set but are issued separately, complete with accessories, spare parts, and wooden carrying chest. The empty chest weighs 100 pounds; with spare parts and accessories it weighs 150 pounds. The motor weighs 124 pounds. The motor runs 40 minutes on one filling ($2\frac{1}{2}$ gallons) of fuel. Fuel mixture information is printed on the gas tank of each motor. To prevent loss of the motors while in use a light line is attached from the motor to the float handrail.

52. TRAILER. The two-wheel pole type utility trailer type I used to transport the infantry-support raft has a truck type suspension and a rectangular-shaped open chassis of steel members. The drawbar is telescopic permitting three adjustments of length for various loadings. The empty trailer weighs approximately 2,400 pounds and will carry a load of 5,000 pounds, but when towed by a loaded $2\frac{1}{2}$ -ton truck the load should not exceed 3,300 pounds (eight assault boats M2). Hand-operated screws, lashings, and chain links hold the load in position.

Section III

Organization and Duties of Working Party

53. GENERAL. **a.** The working party required for the construction of the raft consists of boat-carrying, treadway-carrying, river-assembly, and guy-line details. A suggested organization to construct the raft follows:

<i>Details</i>	<i>Noncom-missioned Officers</i>	<i>Enlisted Men</i>
Boat-carrying-----	1	16
Treadway-carrying -----	1	16
River-assembly-----	1	4
Guy-line -----		4
	—	—
	3	40

b. This organization allows rapid raft construction. When the raft is constructed of boats resting on the shore, there is sufficient personnel provided to launch two boats at a time. When the raft is constructed from boats already afloat, the boat-carrying detail is reduced to eight men, who maneuver the boats into place.

54. BOAT-CARRYING DETAIL. **a.** This detail consists of one noncommissioned officer and 16 men, additional men being added if boats must be carried a long distance. Eight men carry each assault boat.

b. Detail carries, launches, and delivers two boats at a time to river-assembly section. Then it carries, launches, and connects boats for next two pontons of raft. Detail also moves these pontons into place beneath treadway. At certain sites boats are placed individually beneath treadways and then connected into a ponton (par. 61k).

c. Detail then delivers, places, and fastens siderails after treadways have been placed and spaced by treadway-carrying and river-assembly details.

55. TREADWAY-CARRYING DETAIL. **a.** This detail consists of 1 non-commissioned officer and 16 men. Eight men carry a treadway; the number must be increased when it is to be carried a long distance.

b. First pair of treadways is brought down and balanced across first assault-boat ponton.

c. Second pair of treadways is connected. Treadway-carrying detail raises shore ends of connected treadways so boat-carrying details may push second assault-boat ponton under them.

d. Third pair of treadways is connected and third assault-boat ponton inserted as described in **c** above.

e. Detail then places the two approach treadways, as directed by officer in charge, at near-shore end of raft treadways.

56. RIVER-ASSEMBLY DETAIL. **a.** This detail consists of one noncommissioned officer and four men. Detail takes its place in water and receives first two boats from boat-carrying detail.

b. First assault-boat ponton is assembled and held in position by river-assembly detail while first pair of treadways is placed by treadway-carrying detail.

c. When second pair of treadways is connected, river-assembly detail assists in joining them together and then inserts two treadway-connecting pins in each joint to form rigid connection.

d. First assault-boat ponton is shifted into its correct position by river-assembly detail.

e. Detail then assists treadway carriers in connecting third pair of treadways.

57. GUY-LINE DETAIL. This detail consists of four men. It attaches a 50-foot guy line to each end of riverward assault-boat ponton and holds it in position (fig. 49). Lines are payed out as required. When last ponton is placed, guy lines are attached to each end of near-shore ponton. Guy-line detail holds raft with lines while being loaded.

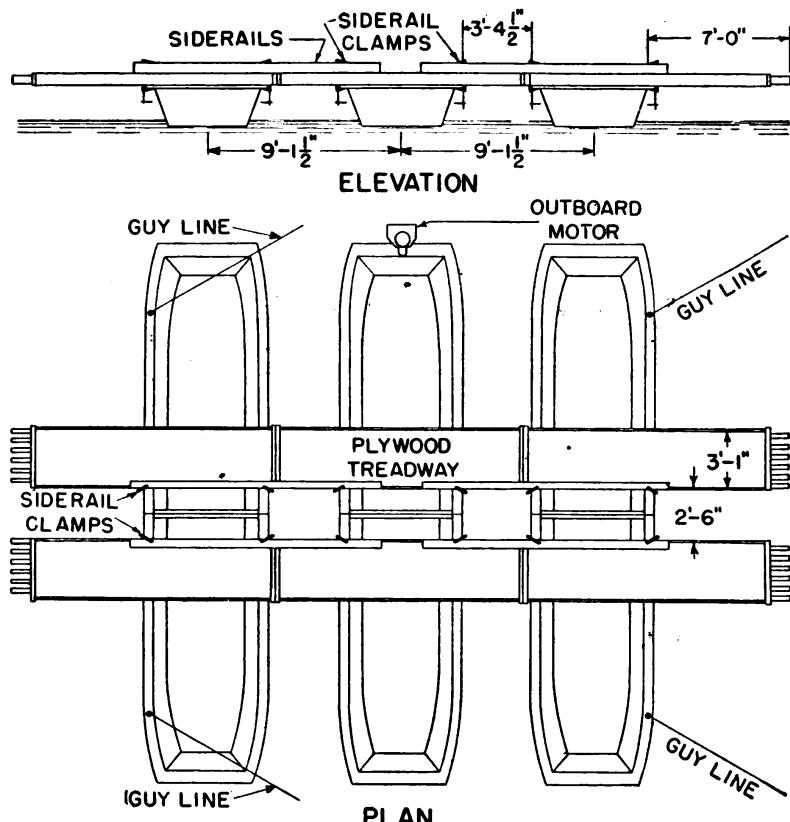


FIGURE 49. *Infantry-support raft.*

Section IV

Construction

58. SITE SELECTION. A raft site should possess the following characteristics:

a. Approaches. Short, easily constructed approach roads from existing road net to site. Prior construction of the near-shore approach often is essential to get raft equipment to the river. The far-shore and near-shore sites need not be directly opposite.

b. Current. A gentle current is desirable. Location of site in a straight reach or gentle bend is favorable.

c. Bed. Bed of river should be free from snags, rocks, shoals, and other obstructions which would interfere with movement of rafts.

d. Banks. Banks should not be so high or steep as to require excessive grading for approach. They should be firm enough to support approach.

e. Cleared area. A small cleared area at near-shore site is needed for unloading and stacking assault boats, treadways, clamps, and other accessories.

f. Tactical considerations. Tactical considerations governing selection of sites are covered in FM 5-6.

59. PREPARATION OF SITE. The site is cleared to provide space for constructing and loading rafts. The raft equipage is moved forward to the construction site. Preparation of the site, including preparation of the treadway support (sec. V), should be completed by the time the assault boats are available for raft construction.

60. PREPARATION OF EQUIPAGE. The raft can be built either directly from the trailer and truck loads or from equipage previously stacked close to the construction site. Extra time is required for raft construction when boat-connecting or treadway-connecting pins are bent, when boat hinge connections are bent, fouled, or iced, or when there is dirt or gravel between treadway fingers.

61. CONSTRUCTION OF RAFT. The equipage for a standard raft consists of 6 assault boats, 6 plywood treadways, 4 siderails, 12 siderail clamps, 1 outboard motor, and 4 guy lines. A completed raft is shown in figure 49. The raft is constructed as follows:

a. Two assault boats are placed stern to stern, parallel to shore, and fastened together with two boat-connecting pins to make an assault-boat



FIGURE 50. *Two assault boats M2 being joined stern to stern.*

ponton (fig. 50). A line fastened to each end is held or payed out as raft is built.

b. Two plywood treadways are balanced across gunwales of ponton between inner treadway spacers (fig. 51).

c. Two more treadways are carried forward and their ends inserted into shore ends of first pair (fig. 52); two treadway-connecting pins are inserted at each joint to form rigid connection.

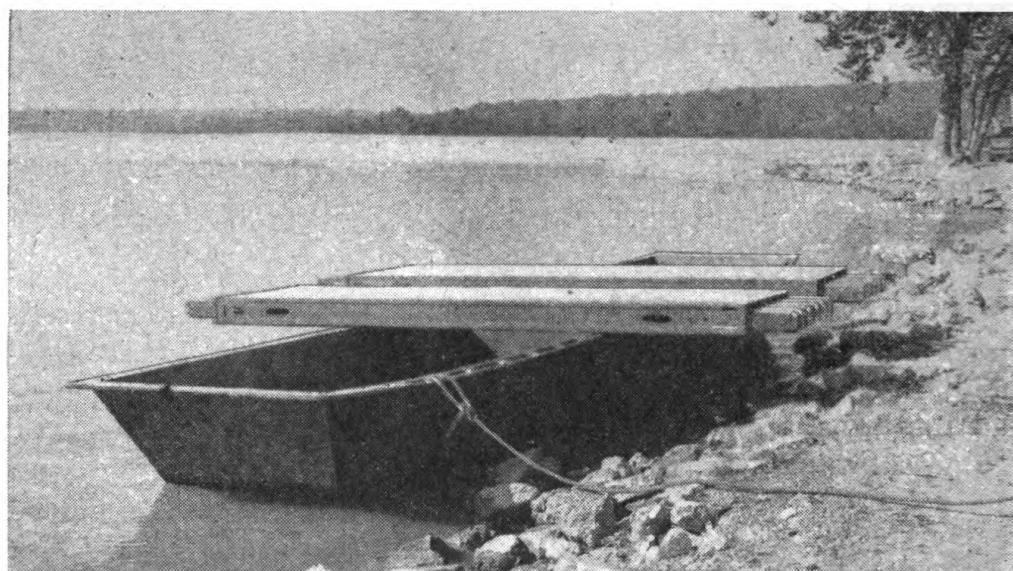


FIGURE 51. *First pair of treadways placed on assault-boat ponton.*

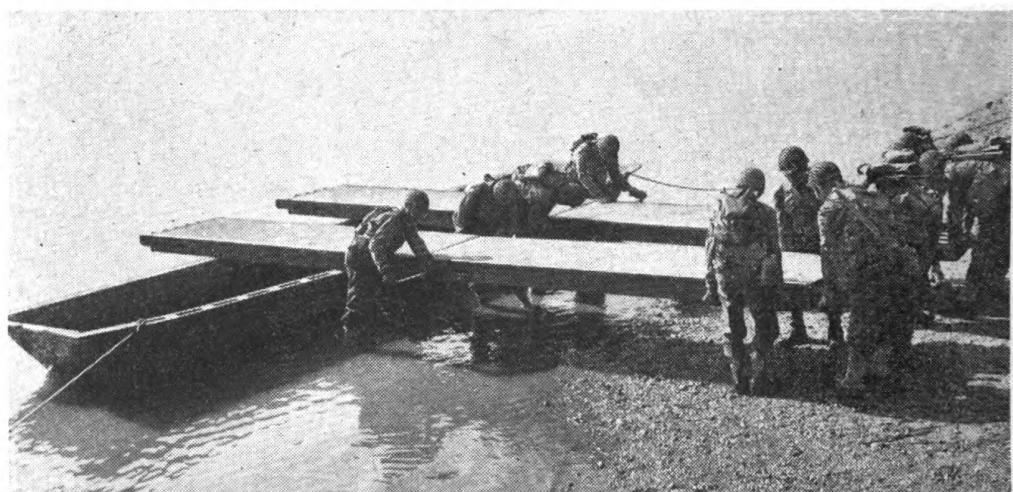


FIGURE 52. *Connecting second pair of treadways.*

d. Shore ends of connected treadways are lifted to allow second assault-boat ponton to be centered under second pair of treadways (fig. 53) and far assault-boat ponton is shifted into correct position as shown in figure 54.

e. Another pair of treadways is connected to second pair. Shoreward ends of treadways are raised to permit third assault-boat ponton to be placed in correct position under them (fig. 55). Joint between second and third pairs of treadways should be next to riverward handrail of third assault-

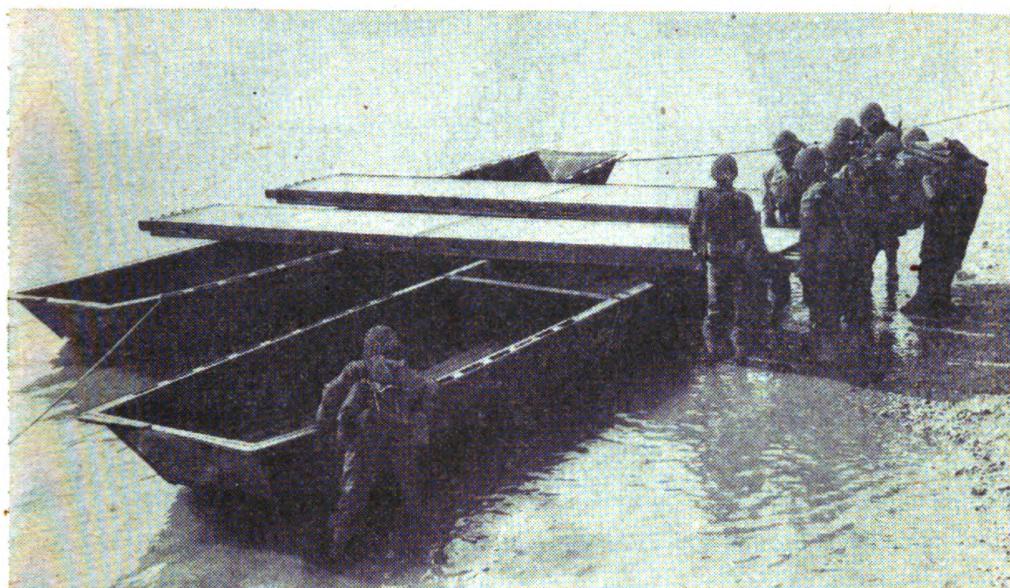


FIGURE 53. *Second assault-boat ponton being installed.*

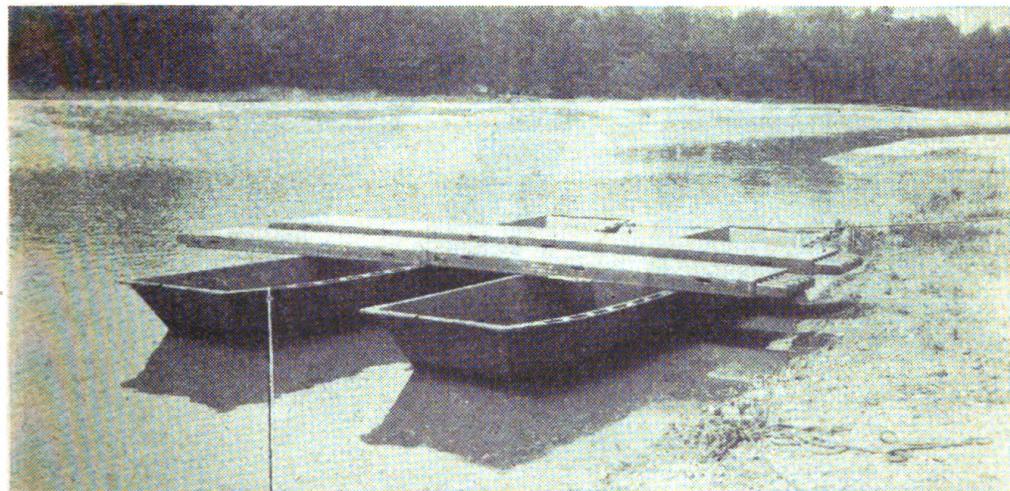


FIGURE 54. *Second assault-boat ponton installed.*

boat ponton. A guy line is fastened to each end of third assault-boat ponton.

f. Siderails are placed above the inside edges of the plywood treadways and across the joints of the treadways (figs. 49 and 56), to give additional rigidity to the deck of the raft. Four siderails are required for the three-assault-boat ponton raft.

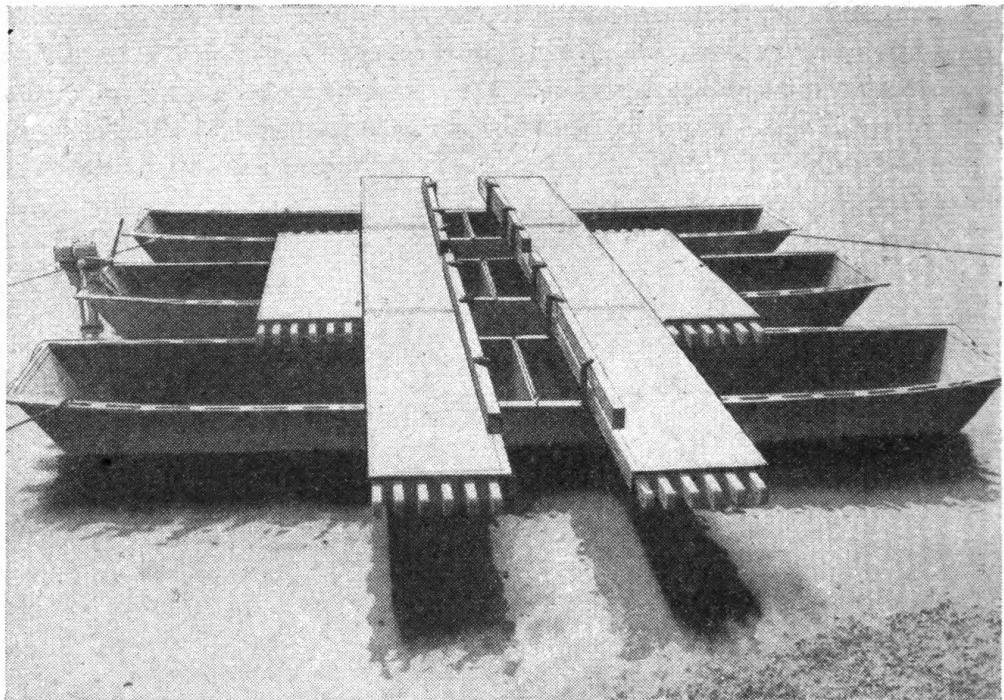


FIGURE 55. *Third assault-boat ponton installed.*

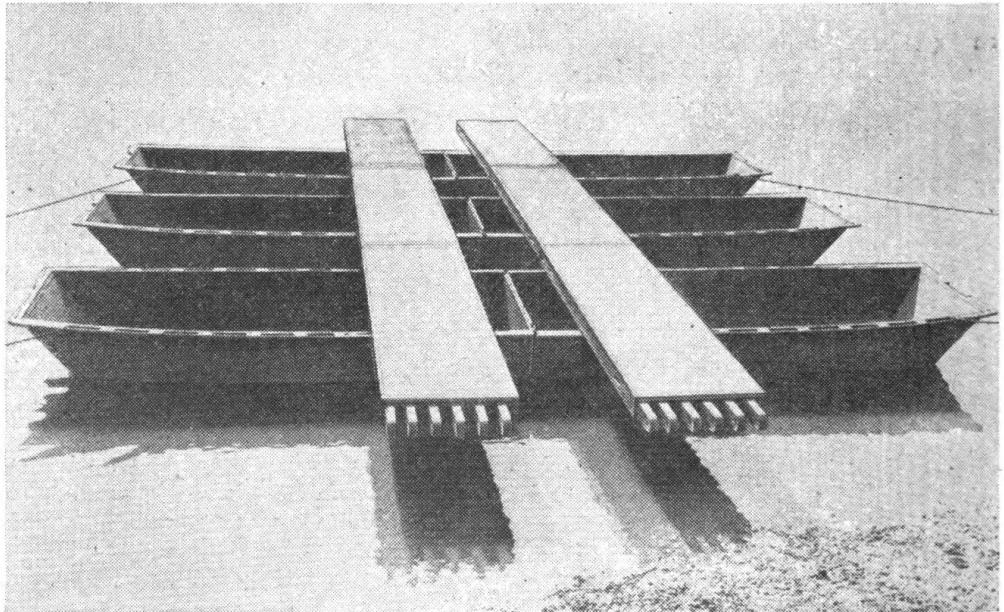


FIGURE 56. *Completed raft.*

g. Twelve siderail clamps (four per ponton) are used to fasten siderails, treadways, and assault-boat pontons together. Screw part of clamp is placed under ponton handrail, fixed part over top of siderail, and clamp is fastened securely.

h. Two treadways used to unload and load raft are placed across gunwales of pontons.

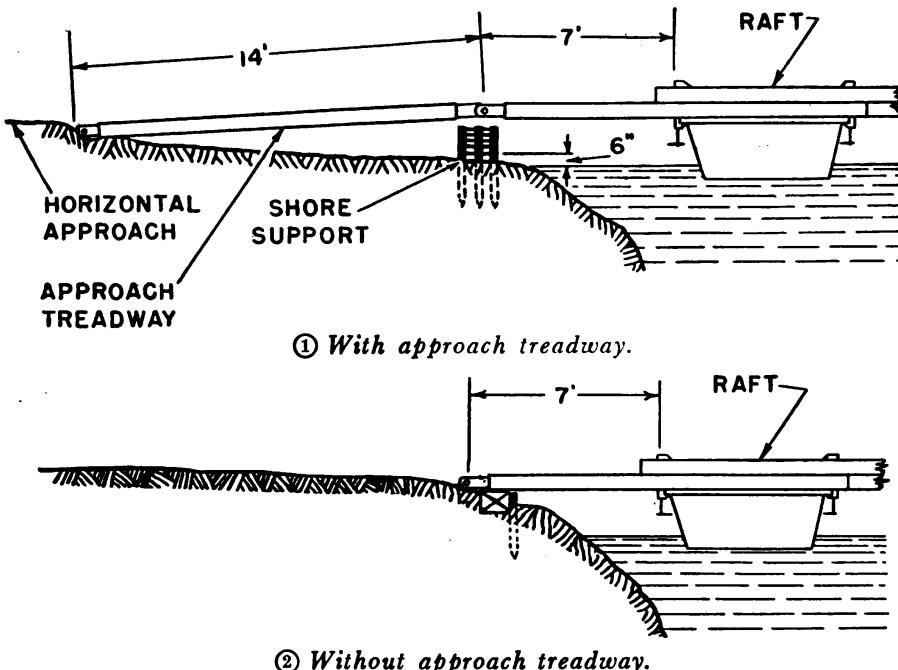
- i. Outboard motor is clamped to downstream end of center ponton (fig. 56) and motor is prepared for operation.
- j. Raft now is complete and ready to transport infantry ammunition and weapons carriers to far shore. Raft is loaded from a previously prepared support (sec. V). Construction of another raft is initiated immediately.
- k. An alternate method for assembling the assault-boat pontoons in streams with narrow construction sites, wooded banks, and swift water offshore, is to insert the boat-connecting pins after the two boats are installed individually under either side of the treadways.

Section V

Treadway Supports

62. GENERAL. A solid support must be provided as a bearing for projecting ends of the shore treadways of the raft when loading or unloading heavy vehicles. This support may be located either in shallow water or on shore. The use of shallow-water supports requires too much time for loading and unloading rafts. Therefore, a shore support should be used whenever possible.

63. SHORE SUPPORT. A shore support is used if the site has sufficient depth of water (20 inches or more) close to shore to float a loaded raft. Lacking such a site, a shelf approach often can be prepared quickly with a bulldozer. The support often is established as shown in figure 57① with its



② Without approach treadway.

FIGURE 57. Shore support.

surface 4 to 6 inches above the water level. It may consist of firm earth cut to grade, a gravel surface, or a sill laid at the proper elevation. An approach treadway is required for loading the raft but not for unloading. With site conditions as shown in figure 57②, the natural bank may be used as a shore support without special preparation. Guy lines hold the ends of the treadways firmly against and upon the sloping bank as vehicles are loaded or unloaded.

64. SHALLOW-WATER SUPPORT. **a.** The shallow-water support is employed where the water close to shore is too shallow to float the loaded raft within reach of a shore support and a shelf approach cannot readily be prepared. It is preferable that there be water at least 20 inches deep within less than 20 feet of shore, as in figure 58①. Approach treadways are connected to shore treadways by hinge joints as shown. The top of the support should be approximately 4 to 6 inches above water level. It may be constructed of chess bound together with rope, or of planks, logs, or cribbing.

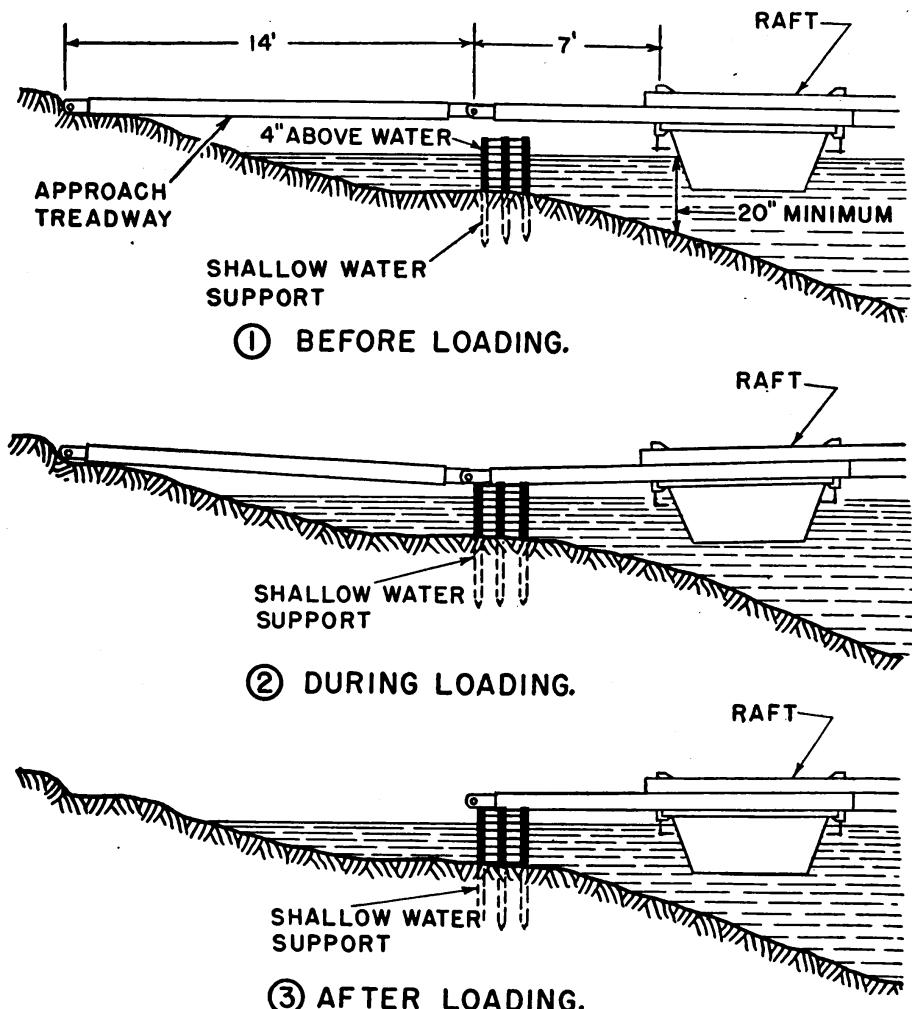


FIGURE 58. *Shallow-water support.*

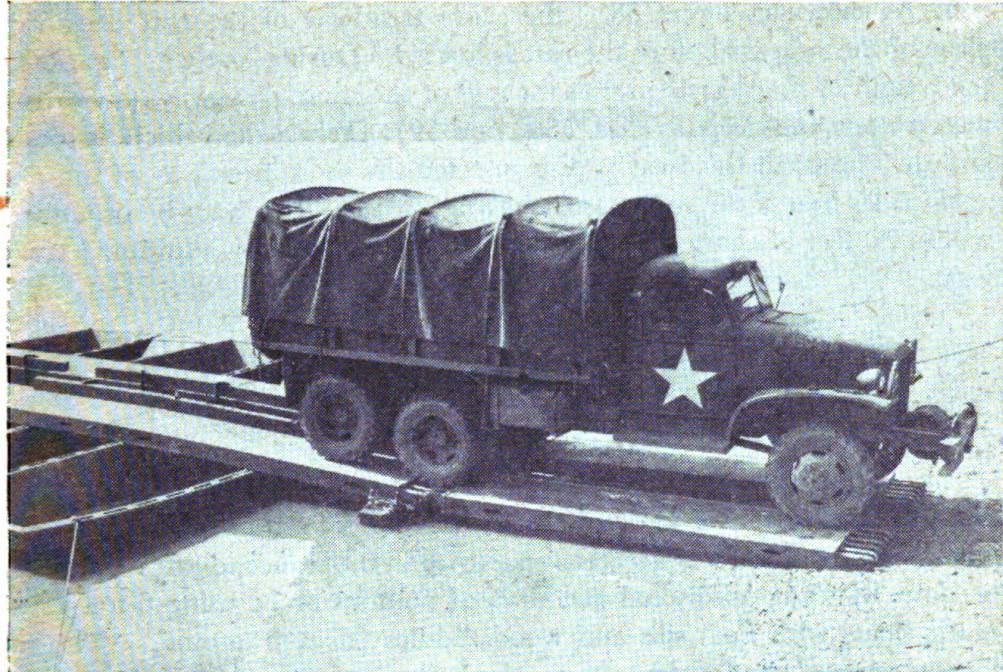


FIGURE 59. Employment of shallow-water support.

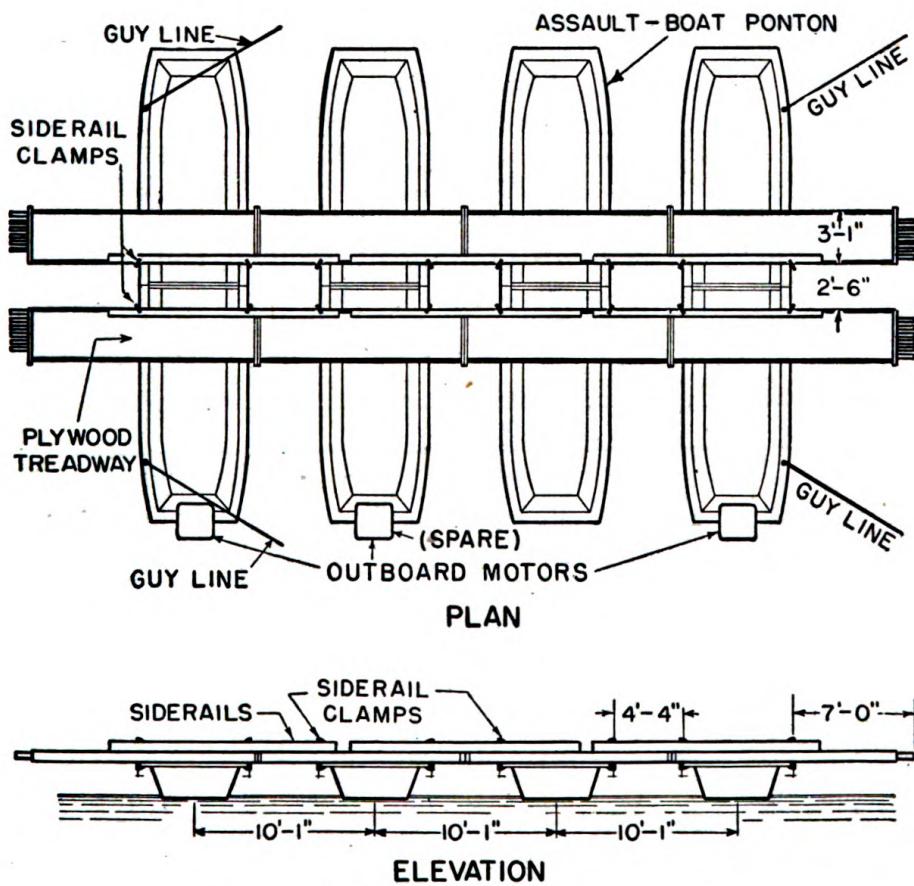


FIGURE 60. Four-assault-boat ponton raft.

b. As shown in figure 58(1) the shore treadway of the raft deck rides clear of the support before the raft is loaded. During loading (fig. 58(2)), the weight of the vehicle presses the end of the shore treadway down firmly to rest upon the support (figs. 58(3) and 59). When the vehicle is loaded and the approach treadway is disconnected the shore treadway of the deck again rides free of the support, as shown. If the raft cannot be brought to within 20 feet of shore the approach can be extended by additional treadways.

Section VI

Reinforced Rafts

65. TYPES. Often it is desirable to use the infantry-support-raft equipment to construct rafts of greater capacity than the standard raft. This can be done by using additional assault-boat pontoons or by using 6-ton pneumatic floats with float sills and wood saddles (float transoms). The following types of reinforced rafts can be built:

- a.** Four-assault-boat ponton raft (fig. 60).
- b.** Five-assault-boat ponton raft (figs. 61 and 62).
- c.** Seven-assault-boat ponton raft (figs. 63 and 64).

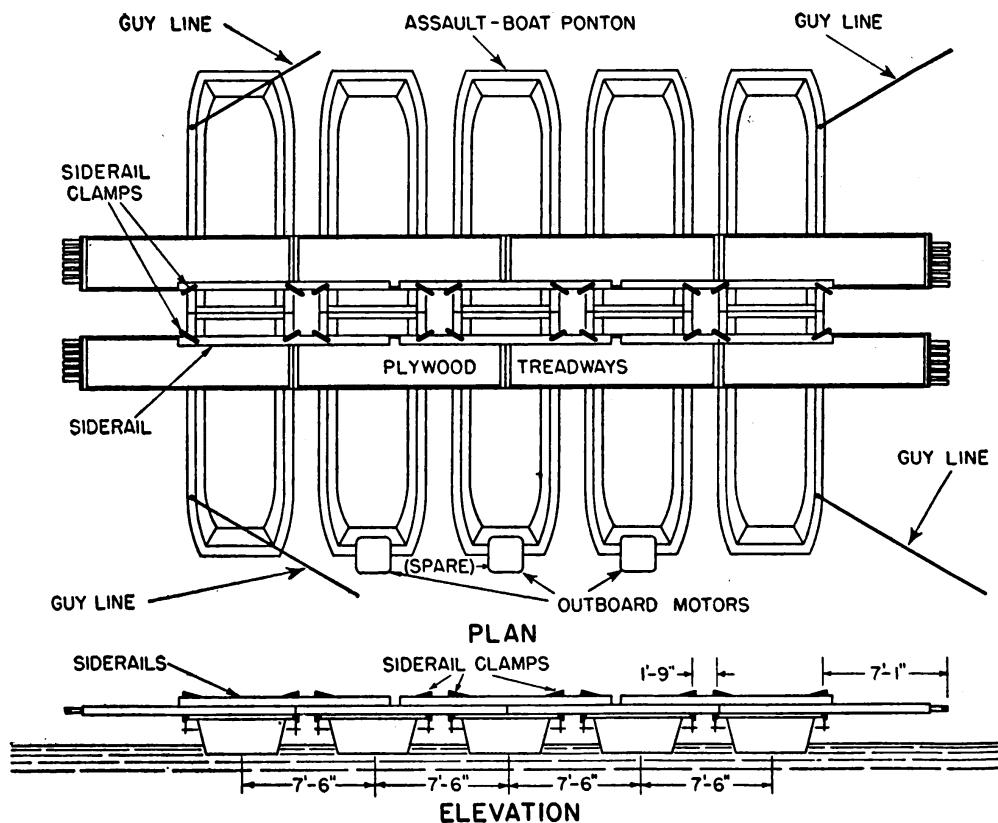


FIGURE 61. Five-assault-boat ponton raft.

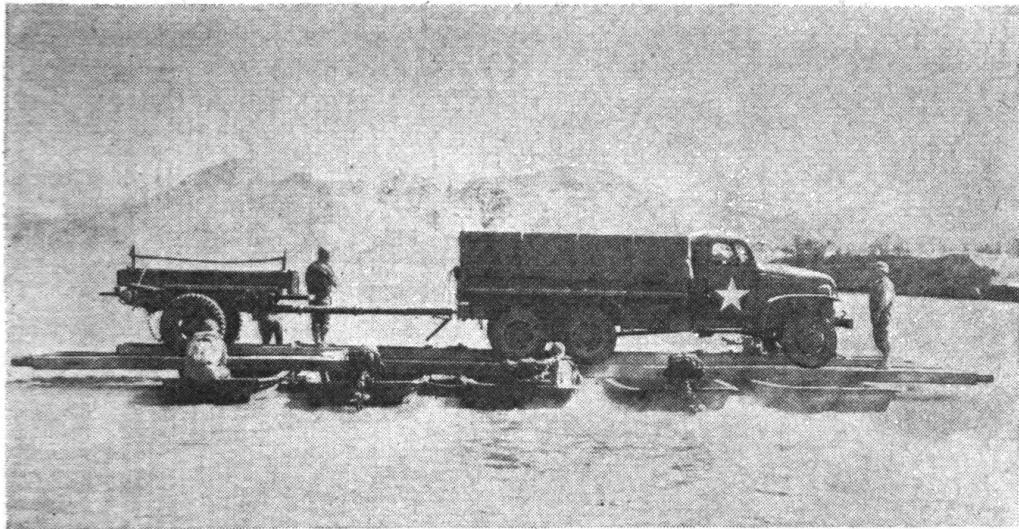


FIGURE. 62. Five-assault-boat ponton raft in operation. Load is 2½-ton truck towing a simulated 105-mm howitzer.

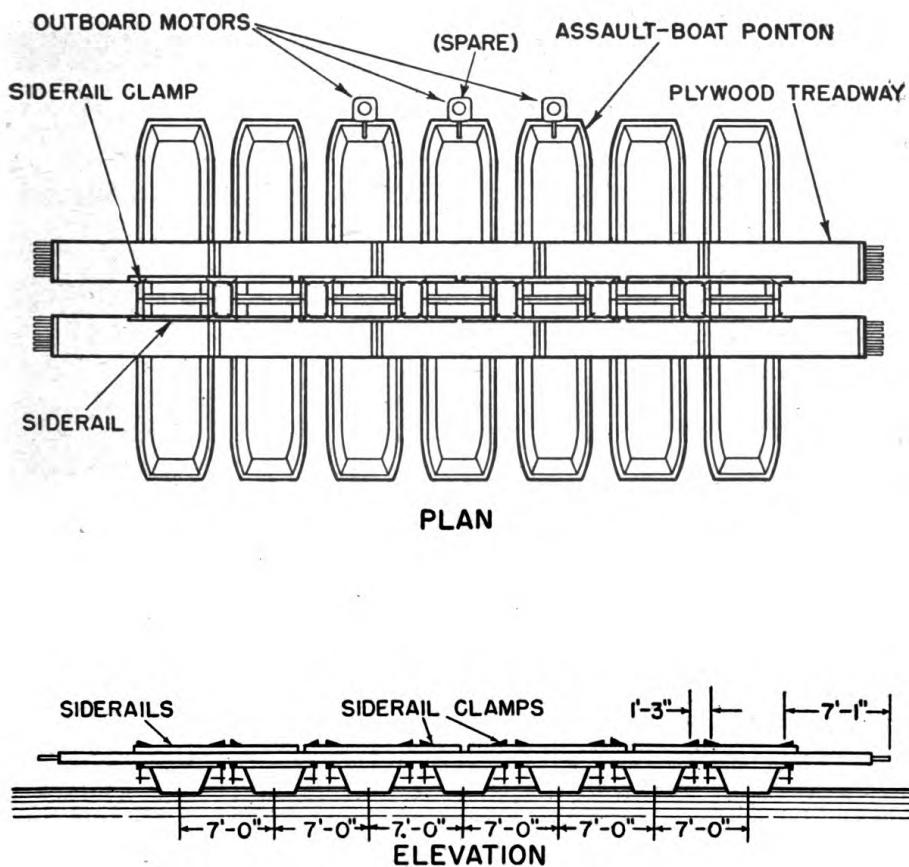


FIGURE 63. Seven-assault-boat ponton raft.

d. Three-assault-boat ponton raft, reinforced with two 6-ton floats (figs. 65 and 66).

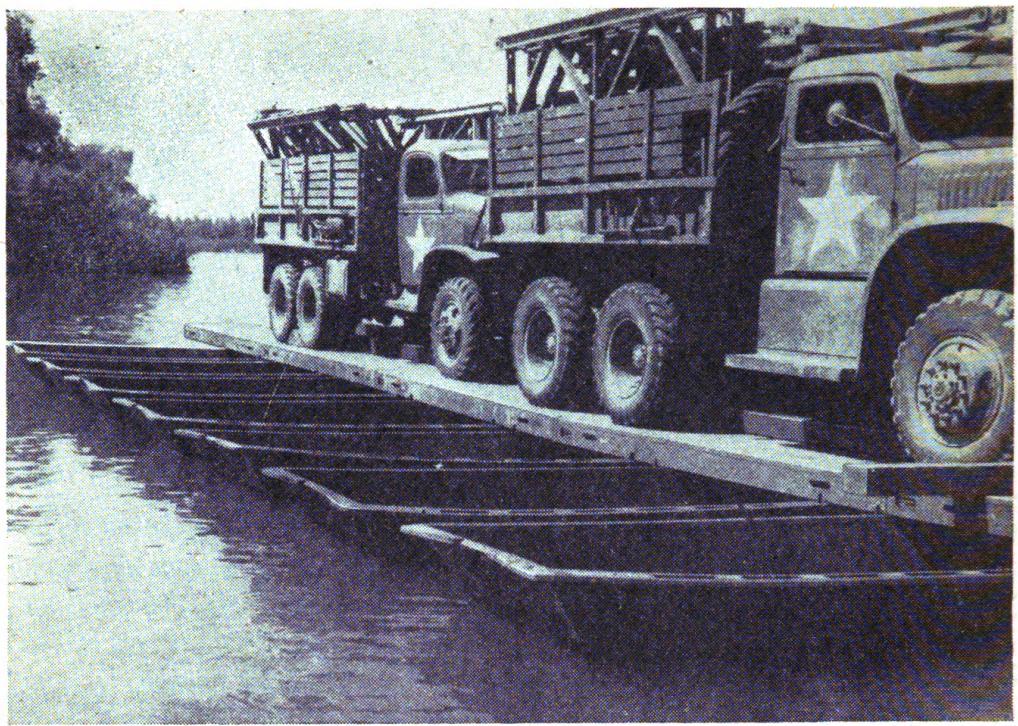


FIGURE 64. Seven-assault-boat ponton raft. Load is two trucks, a 2½-ton and a 4-ton.

e. Four-assault-boat ponton raft, reinforced with three 6-ton floats (figs. 67 and 68).

66. COMPOSITION. Table IV shows the composition of the various types of reinforced rafts.

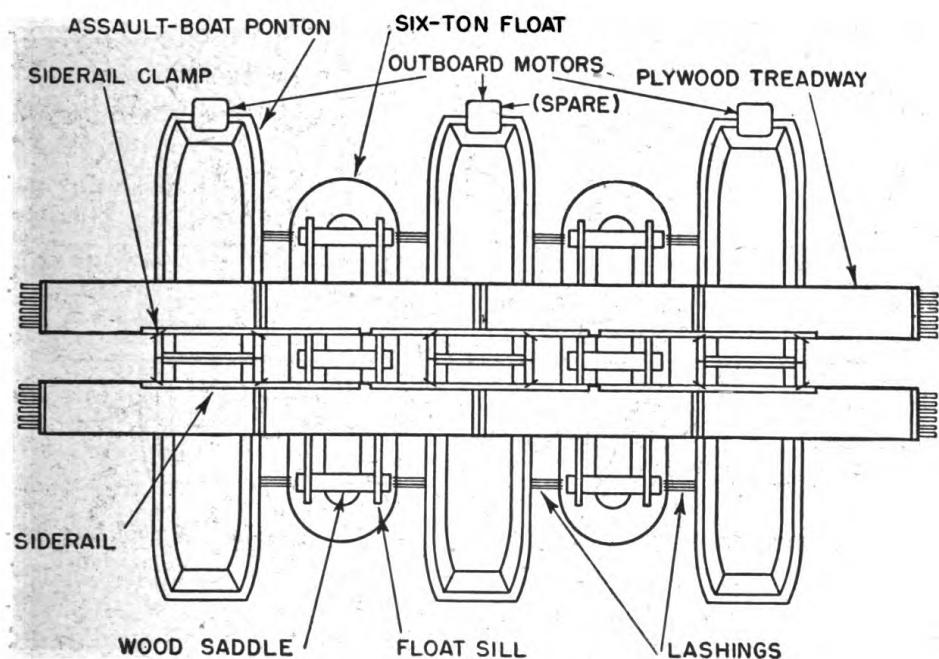
TABLE IV. *Composition of reinforced rafts*

Article	Assault-boat rafts				
	Four-ponton	Five-ponton	Seven-ponton	Three-ponton reinforced with 2 floats	Four-ponton reinforced with 3 floats
Assault boat M2.....	8	10	14	6	8
Siderail.....	6	6	8	6	8
Clamp, siderail.....	16	20	28	12	16
Treadway, plywood.....	8	8	10	8	10
Rope, manila, $\frac{1}{2}$ -inch, 50-foot.....	4	4	4	4	4
Rope, manila, $\frac{1}{2}$ -inch, 12-foot (lashing).....	.....	.....	.....	8	12
Motor, outboard, 22-horse-power ¹	3	3	3	3	3
Six-ton pneumatic floats.....	.....	.....	.....	2	3
Float sill ².....	.....	.....	.....	4	6
Wood saddles ³.....	.....	.....	.....	6	9

¹ Twenty-two-horsepower outboard motors are not part of the infantry-support-raft set, but are issued separately. One motor on each raft is used as a spare.

² Float sills may be trestle balk, chess, or suitable dimensional lumber.

³ Wood saddles are 3- by 12-inch by 6-foot dimensional lumber.



PLAN

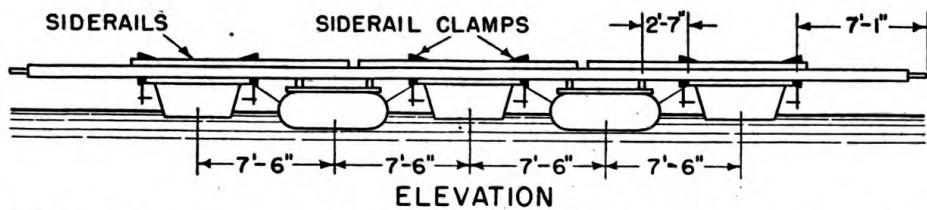


FIGURE 65. Three-assault-boat ponton raft, reinforced with two 6-ton floats.

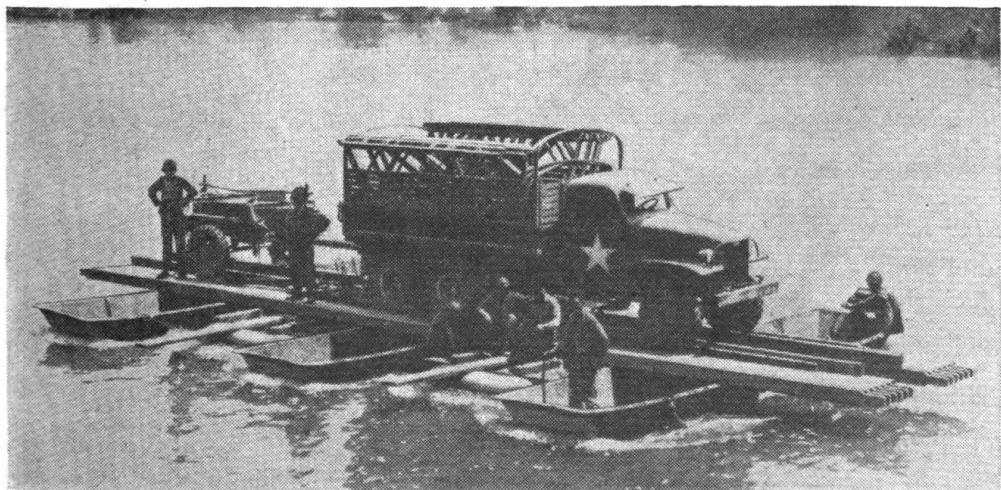
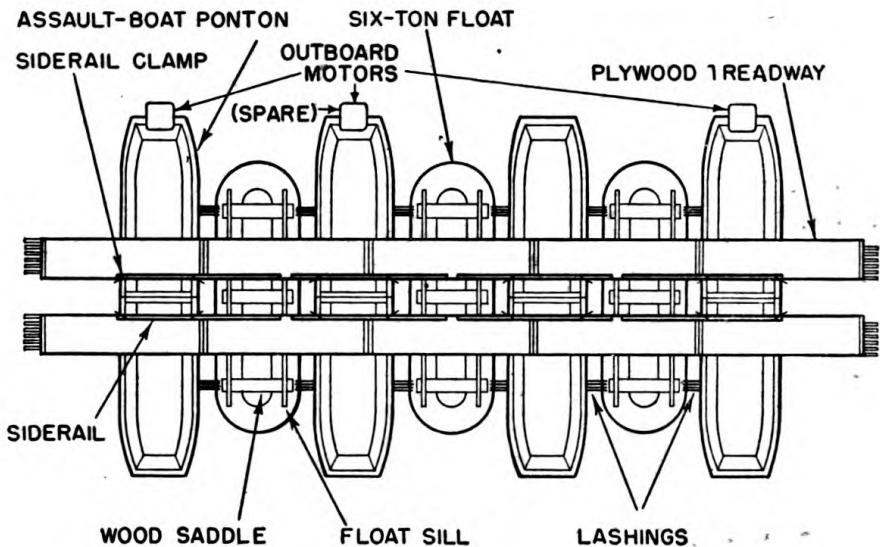
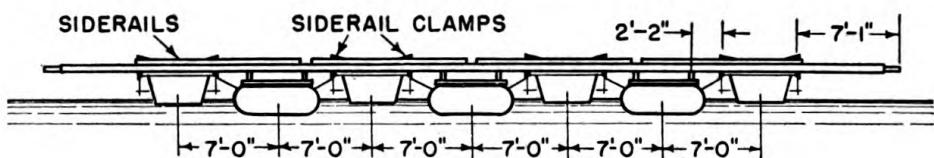


FIGURE 66. Three-assault-boat ponton raft, reinforced with two 6-ton floats. Load is a 2½-ton truck towing a simulated 105-mm howitzer.



PLAN



ELEVATION

FIGURE 67. Four-assault-boat ponton raft, reinforced with three 6-ton floats.

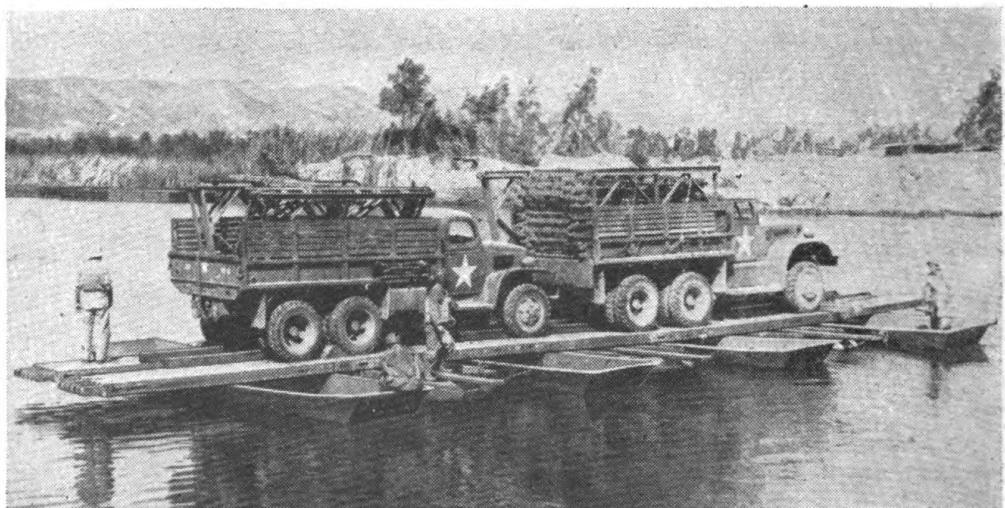


FIGURE 68. Four-assault-boat ponton raft, reinforced with three 6-ton floats; Load is two trucks, a 2½-ton and a 4-ton.

67. CONSTRUCTION. For reinforced rafts employing assault boats only, the size and organization of the working party is as described in section III. For reinforced rafts employing 6-ton pneumatic floats, float-inflation and float-assembly details (see table VII) must be added. The construction of the reinforced rafts is similar to that of the standard raft described in section IV, with the following exceptions:

a. Four-assault-boat ponton raft. (1) An additional assault-boat ponton and one additional pair of treadways are used.

(2) The six siderails are placed across the joints of the plywood treadways and are clamped as shown in figure 60.

(3) Outboard motors are placed on the two outer assault-boat pontons, and a spare motor is mounted on either inner ponton.

b. Five-assault-boat ponton raft. (1) Two additional assault-boat pontons and one additional pair of treadways are used.

(2) The six siderails are placed across the joints of the plywood treadways and are clamped as shown in figure 61.

(3) Outboard motors are placed on the three interior assault-boat pontons, the spare motor on the middle ponton.

c. Seven-assault-boat ponton raft. (1) Four additional assault-boat pontons and two additional pairs of treadways are used.

(2) The eight siderails are placed across the joints of the plywood treadways and are clamped as shown in figure 63.

(3) Outboard motors are placed on the three interior assault-boat pontons, the spare motor on the middle ponton.

d. Three-assault-boat ponton rafts, reinforced with two 6-ton floats.

(1) Two 6-ton pneumatic floats are assembled each with three wood saddles placed across the float and two float sills placed lengthwise and on top of the outer tubes and held in place by tie-down straps. The assembled floats are inserted between the assault-boat pontons and are lashed at their corners to the handrails of the assault-boat pontons.

(2) One additional pair of treadways is used.

(3) The six siderails are placed across the joints of the plywood treadways and are clamped as shown in figure 65.

(4) Outboard motors are placed on all of the assault-boat pontons, the spare motor on the middle ponton.

e. Four-assault-boat ponton raft, reinforced with three 6-ton floats.

(1) One additional assault-boat ponton and two additional pairs of plywood treadways are used.

(2) Three 6-ton pneumatic floats, assembled and lashed as described in paragraph d (1) above are inserted between the assault-boat pontoons.

(3) The six siderails are placed across the joints of the plywood treadways and are clamped as shown in figure 67.

(4) Outboard motors are placed on the two end assault-boat pontoons, and a spare motor on either of the inner ones.

68. CHOICE OF RAFTS. The five-assault-boat ponton raft is the best all-purpose raft. It has greater capacity than three- and four-assault-boat ponton rafts and is safer and more maneuverable in currents. Although the seven-assault-boat ponton raft has a greater capacity than the five-ponton raft, it is less maneuverable.

Section VII

Operation

69. FERRY SITES. **a.** Ferry sites should have the following technical characteristics:

- (1) Moderate stream current.
- (2) Firm, gently sloping banks on both shores with space to operate two or more rafts.
- (3) Far- and near-shore sites opposite one another. Second best arrangement is to locate unloading site downstream from loading site.
- (4) Water close to bank deep enough so shore support can be used without preparation. (See sec. V.)

b. Desirable tactical characteristics are given in FM 5-6.

c. Generally only two rafts are used at one site where the river is less than 500 feet wide. On wider streams three rafts can be used effectively without interference.

70. FERRY PARTY. The ferry party is under the supervision of an officer or noncommissioned officer, and is divided into a raft crew, a near-shore crew, and a far-shore crew. Table V gives a suggested organization for the ferry party at sites where shallow-water treadway supports are not used. When such supports are used additional men must be assigned to place them.

TABLE V. *Organization of ferry party*

Crew	Number of men	Duties
Raft ¹	4 or 5 ²	2 or 3 ² men operate the outboard motors. 2 men place and remove chocks from wheels of vehicles, and toss out guy lines to shore crews.
Near-shore.....	5.....	1 man guides vehicles onto raft and instructs drivers in proper operation of vehicle while being loaded and unloaded.
Far-shore ³	5.....	4 men on guy lines. 1 man guides vehicles off raft. 4 men on guy lines.

¹ Two rafts can be used at any site, and three when streams are over 500 feet wide. In such cases, two or three raft crews are employed.

² On a three-ponton raft one operator and one assistant are required, and on reinforced rafts, two operators and one assistant.

³ If only one raft is used at a site near- and far-shore crews can be eliminated and ferry party changed to consist of outboard motor operators, guide, and four guy-line men.

71. LOADING AND UNLOADING RAFTS. The following rules are observed in loading and unloading:

- a. Guy ropes are firmly secured.
- b. Vehicles move on and off the raft at slow speed. Vehicles having all-wheel drive use it.
- c. When treadway supports are used, rafts are accurately placed with respect to them (see figs. 57 and 58).
- d. To obtain greater freeboard and more speed, vehicles are placed as far as possible toward the downstream side of the deck.
- e. Rafts carry anchors, lashings, boat hooks, and paddles for use in an emergency.

72. EMPLOYMENT OF OUTBOARD MOTORS. a. (1) A three-ponton raft uses one outboard motor (fig. 69). On reinforced rafts, three motors are mounted, two for propulsion and the third as a spare. In an emergency, one motor can propel a reinforced raft, but at greatly reduced speed.

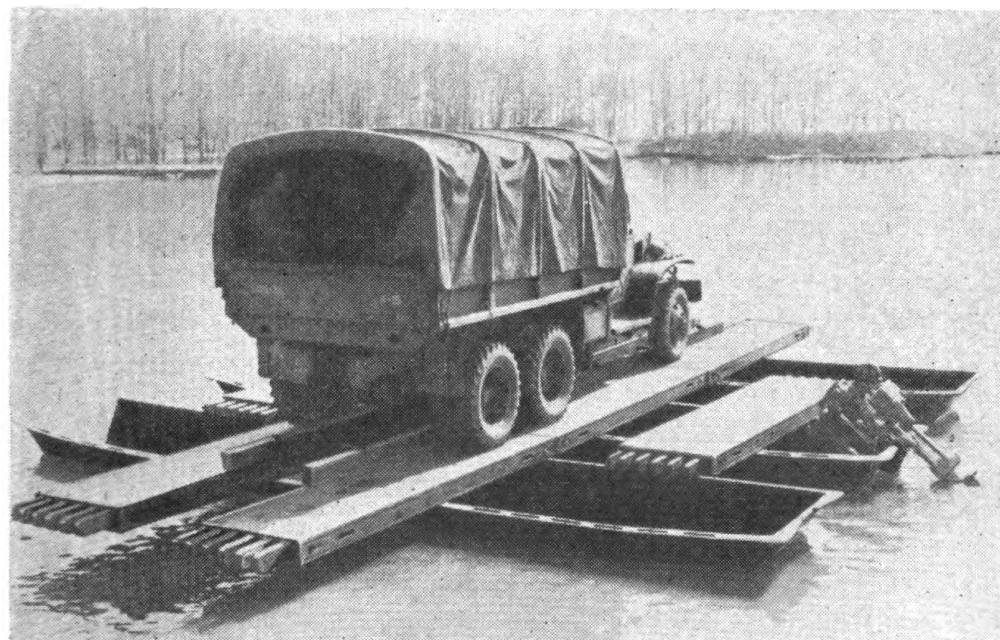


FIGURE 69. Standard raft carrying 2½-ton truck.

(2) An alternate method of propelling a raft is to mount the motor on a separate assault boat employed as a powerboat. For loads and speeds requiring more than one motor, two assault boats can be used effectively. This method is used only when motors cannot be mounted directly on assault-boat pontons in a raft.

b. When moving from slack water upstream against a current, speed is reduced to eliminate surge against the bow of the assault-boat pontons.

Entering relatively swift currents with the raft moving rapidly, this surge may swamp the pontoons. Once the raft has completely entered the current, speed may be resumed without danger.

c. Motors can be used only in streams of sufficient depth. The propeller may be damaged by driftwood and must be kept away from marine vegetation.

d. Successful raft operation depends chiefly on the performance of the outboard motors. The operators must be well schooled in motor operation and maintenance. A specific motor should be assigned to each operator.

73. TIME REQUIRED FOR CROSSING. a. The three-ponton raft propelled by one motor moves about 8 feet per second unloaded and 3.5 feet per second loaded; propelled by two motors, it moves about 11 feet per second unloaded and 8 feet per second loaded. The time required to load and unload a raft varies with the type of site and whether or not a treadway support is employed.

b. The following is a record of an actual crossing:

(1) Conditions:

River	400 feet wide.
Current	7 feet per second.
Raft	Five-assault-boat ponton.
Motive power	3 outboard motors.
Ferry party	As described in paragraph 70.
Site conditions	Shore supports, no approach treadways, and far-shore site opposite near-shore site.
Loads	Various.

(2) Result:

Number of round trips in 5 hours	50.
Time required for average trip	6 minutes.
Break-down of average round trip:	

Loading vehicle	1 minute.
Crossing	1 minute.
Landing on far shore	1 minute.
Unloading vehicle	1 minute.
Return crossing	1 minute.
Landing on near shore	1 minute.

Total 6 minutes.

The shortest time for a round trip was 4 minutes.

NOTE. The above record was made by a trained crew. A week prior to the record mentioned above the same crew, then untrained, averaged 11 minutes per round trip at the same site and under the same conditions.

Section VIII

Expedient Assault-Boat Bridges

74. PURPOSE AND CAPACITY. **a.** Infantry-support raft equipage may be used as an expedient to construct a bridge that will carry the ammunition and weapons carriers of an infantry division. However, because of the light construction of both boats and treadways the bridge should not be left in continuous use. The bridge is held in position with the ferry-set material described in chapter 9. Approximately 190 feet of bridge can be built from the materials of six rafts.

b. Table VI gives the capacity in various stream velocities of the expedient assault-boat bridge normally constructed and reinforced with either assault-boat pontons or 6-ton pneumatic floats. It also lists typical vehicles that may cross.

75. SITE SELECTION AND PREPARATION. The selection of the bridge site is based on the same factors as the infantry-support-raft site except there must be a satisfactory far-shore site directly opposite the near-shore site. The approach roads to the expedient bridge require more preparation and maintenance than raft-site approach roads because of the greater volume of traffic handled by the bridge.

76. TYPES OF BRIDGE. **a. Decking.** The expedient assault-boat bridge may be built either with a double-treadway deck similar to that of the infantry-support raft, or with a solid, or triple-treadway deck.

b. Flotation. (1) NORMAL CONSTRUCTION. In the normal bridge assault-boat pontons are spaced at intervals of 10 feet center to center (fig. 70).

(2) REINFORCED CONSTRUCTION. The bridge can be reinforced by spacing assault-boat pontons at intervals of 6 feet center to center. Six-ton pneumatic floats may replace *alternate* assault-boat pontons without affecting the capacity. (See table VI.)

77. EXPEDIENT ASSAULT-BOAT BRIDGE WITH DOUBLE-TREADWAY DECK. **a.** The double-treadway bridge (fig. 70) has the following advantages over the triple-treadway bridge (fig. 73):

- (1) Constructed more quickly.
- (2) Requires fewer treadways.
- (3) Requires smaller construction party.

b. The double-treadway bridge has the following disadvantages as compared with the triple-treadway bridge:

- (1) Considerably less traffic capacity, especially at night, when care must be taken to keep on treadways.

VEHICLE	WEIGHT CLASS - TONS	EXPEDIENT ASSAULT-BOAT BRIDGE							
		NORMAL	REINFORCED with Pontons or 6-Ton Floats						
CAPACITY IN TONS POSTED ON BRIDGE									
		5	6	8	7	9	13		
MAXIMUM STREAM VELOCITY IN FEET PER SECOND				7	5	3	7	5	3
		LEGEND  SAFE  CAUTION ①  UNSAFE W/ = WITH							
Truck, 1/4-T	2								
Truck, 1/2-T, all types	3								
Truck, 3/4-T, all types	4								
Truck, 1/2-T, w/1-T tlr.	4								
Car, scout, M3A1	5								
Truck, 1 1/2-T, all types	5								
Truck, 1 1/2-T, w/1-T tlr.	6								
Truck, 1 1/2-T, w/105-mm How.	6								
Truck, 1 1/2-T, w/camera tlr.	8								
Compressor, air, mtzd. 6 x 6 (Engr.)	7								
Water purification unit, mobile (Engr.)	8								
Truck, 2 1/2-T, all types	8								
Car, armored, light, M8	8								
Car, half-track, M2	9								
Truck, 2 1/2-T, w/1-T tlr.	9								
Truck, 2 1/2-T, w/105-mm How.	9								
Sterilizer unit (Medical)	10								
Tractor, D-4, w/dozer	7	③	③	③	③	③	③	③	③
Grader, road, mtzd. (Engr.)	11								
Truck, 4-T, wrecker	11								
Truck, 2 1/2-T, w/155-mm How., carr. M1	11								
Crane, trk.-mtd. (Engr.)	12								
Tank, light, M2A4	12								
Truck, 4-T, cargo	13								
Truck, 4-T, ponton	13								
Crane, trk.-mtd., w/crane atchmnts. tlr.	15								
Truck, 4-T, w/155-mm How., carr. M1	16								
Tank, light, M3	14						②	②	

NOTES

- ① Caution means vehicle must cross as far as possible on downstream side of bridge deck.
- ② Unsafe because treadway joints are overstressed.
- ③ Will cross only on triple-treadway deck.

TABLE VI. Capacity of expedient assault-boat bridge. Posted capacity of bridge may be exceeded if this chart indicates vehicles can cross.

- (2) Unsuitable for crossing horses or mules, because of center gap.
- (3) Unsuitable for crossing solo motorcycles.

78. CONSTRUCTION OF DOUBLE-TREADWAY BRIDGE. Construction of the double-treadway bridge is generally similar to that of the infantry-support raft. The following organization is suggested for construction by successive floats, using the equipage as it is unloaded from its transportation:

One officer, to supervise construction

<i>Details</i>	<i>Noncom-missioned Officers</i>	<i>Enlisted Men</i>
Boat-carrying	1	16
Treadway-carrying	1	16
River-assembly	1	10
Siderail	1	8
Guy-line	1	1 per line
or		
Anchor-cable	1	8

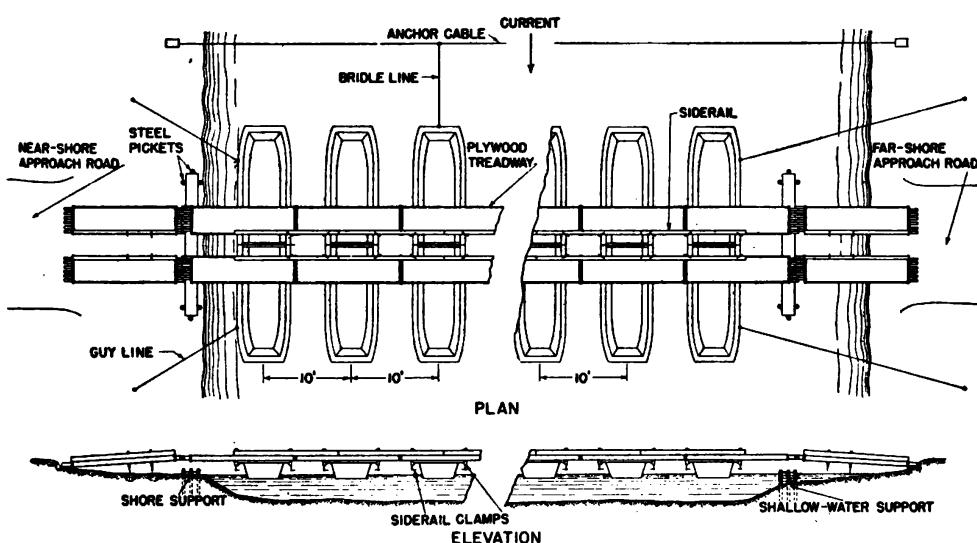


FIGURE 70. *Assault-boat bridge with double-treadway deck.*

79. DUTIES OF WORKING PARTY. **a. Boat-carrying detail.** This detail consisting of 1 noncommissioned officer and 16 men carries the assault boats 2 at a time from the trucks to the river, and launches them. Eight men carry each boat.

b. Treadway-carrying detail. This detail, consisting of 1 noncommissioned officer and 16 men, carries the treadways to the river and places the treadway fingers into those of the treadways in the completed portion of the bridge so as to form a rigid joint between treadways. Treadways are spaced between the inner set of treadway spacers as in the rafts. Each treadway is carried by 8 men.

c. Siderail detail. The siderail detail, consisting of one noncommissioned officer and eight men, delivers, places, and clamps the siderails to the assault-boat pontons. Siderails are placed with their 6-inch side vertical above the inside edges of the plywood treadways and across the treadway joints. They are clamped to the ponton handrails with siderail clamps placed screw part down. Siderails are secured to approach treadways by siderail clamps placed with screw parts down; if necessary, holes are dug in the bank to prevent the lower ends of these clamps from striking the ground when vehicles pass over the treadways. Siderails cannot be placed on their 6-inch sides on the inside of the treadways and still accommodate the $\frac{1}{4}$ -ton truck.

d. River-assembly detail. (1) The river-assembly detail, consisting of 1 noncommissioned officer and 10 men, connects the assault boats to form assault-boat pontons and places the treadway-connecting pins in the treadway joints. The first bay of the bridge is constructed with treadways located the same on the assault-boat ponton as on the infantry-support raft. The second and following assault-boat pontons are spaced 10 feet apart, center to center.

(2) Four men couple the assault boats to form assault-boat pontons, and two men move them. Four men insert treadway-connecting pins and shift the assault-boat pontons under the treadways as required. The noncommissioned officer directs the near-shore assembly of the bridge.

e. Guy-line detail. The guy-line detail consists of one noncommissioned officer and one man per guy line. Guy lines may be used when the length of the bridge does not exceed 150 feet and the current does not exceed 3 miles per hour; otherwise, anchor cables should be used. The guy-line detail attaches guy-lines to the upstream and downstream ends of the far-shore assault-boat ponton and to every sixth assault-boat ponton from it.

f. Anchor-cable detail. When an anchor cable is used a detail of one noncommissioned officer and eight men is needed to erect and maintain it.

(1) The anchor detail unloads the materials and the assault-boats required for erecting the cable.

(a) Two men who construct the near-shore hold-fast carry the hold-fast and its pickets, one ratchet chain hoist, four cable clips, two cable grips, and the necessary tools to the point designated by the noncommissioned officer as the location for the near-shore hold-fast.

(b) The remaining six men load into the boat the anchor cable, two improvised range poles, four cable clips, one hold-fast with nine pickets, and the necessary tools and lashings for the construction and maintenance of the far-shore hold-fast.

(2) The free end of the cable is passed from the boat to the two men who prepare the near-shore hold-fast. The noncommissioned officer steers the boat as it moves across the stream.

(3) Upon reaching the far shore the noncommissioned officer places range poles marking the far-shore center line of the bridge. He then designates the location of the far-shore anchor-cable hold-fast. The cable is attached to the completed hold-fast by four cable clips and then is tightened on the near shore (figs. 71 and 72).

(4) One man remains on the far shore to maintain the far-shore hold-fast; the noncommissioned officer and the remaining five men paddle back to the near shore.

(5) One man remains to maintain the near-shore hold-fast.

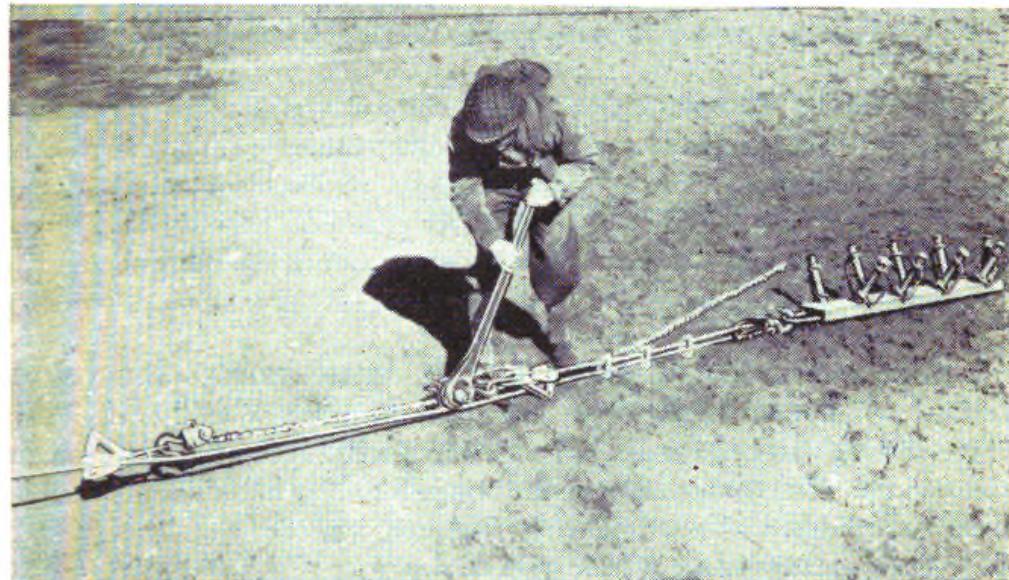


FIGURE 71. *Man tightening anchor cable attached to holdfast.*

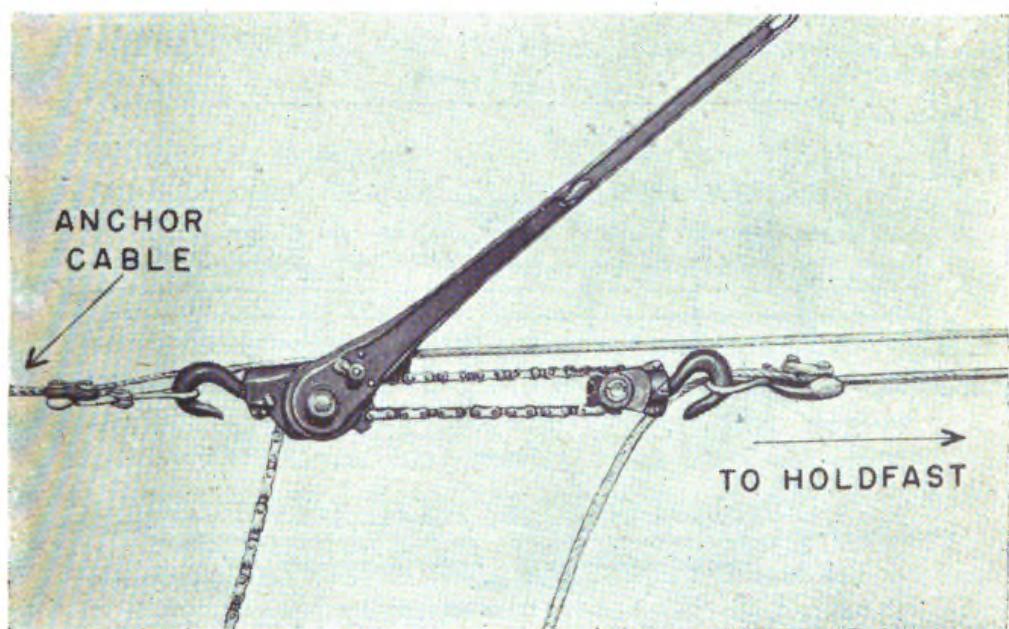


FIGURE 72. *Ratchet chain hoist used with cable grips to adjust anchor-cable tension.*

(6) The noncommissioned officer directs the attachment of the bridle lines to the anchor cable from the assault-boat pontons. One bridle line is attached to the third assault-boat ponton from the far-shore end of the bridge and to every sixth assault-boat ponton from it. Each man attaches one end of a bridle line to the anchor cable, takes his place in an assault-boat ponton as directed by the noncommissioned officer, adjusts the length of the bridle line as the assault-boat ponton moves across the stream, and makes the final adjustment of the bridle line when the bridge reaches the far shore.

(7) A rope may be attached to the far-shore end of the bridge to pull the completed portion toward the far shore as the bridge is constructed.

80. ABUTMENT CONNECTIONS. The ends of the floating portions of the bridge are connected to shore by hinge-joint-connected treadways. Supports for loading or unloading similar to those required for the rafts (par. 63 and figs. 57 and 58) are also required for expedient assault-boat bridges. Guy lines are attached to assault-boat pontons and to the shore to assist in holding the bridge in place (fig. 70).

81. EXPEDIENT ASSAULT-BOAT BRIDGE WITH TRIPLE - TREADWAY DECK. **a. Construction.** The expedient triple-treadway bridge uses three plywood treadways per bay to make a solid deck of 8 feet 8 inches clear width. The construction of this bridge is similar to that of the double-treadway bridge, with the following exceptions (fig. 73):

- (1) Three treadways are used instead of two.
- (2) Two ramp side connectors (par. 46) are inserted between each outer treadway and the middle treadway.

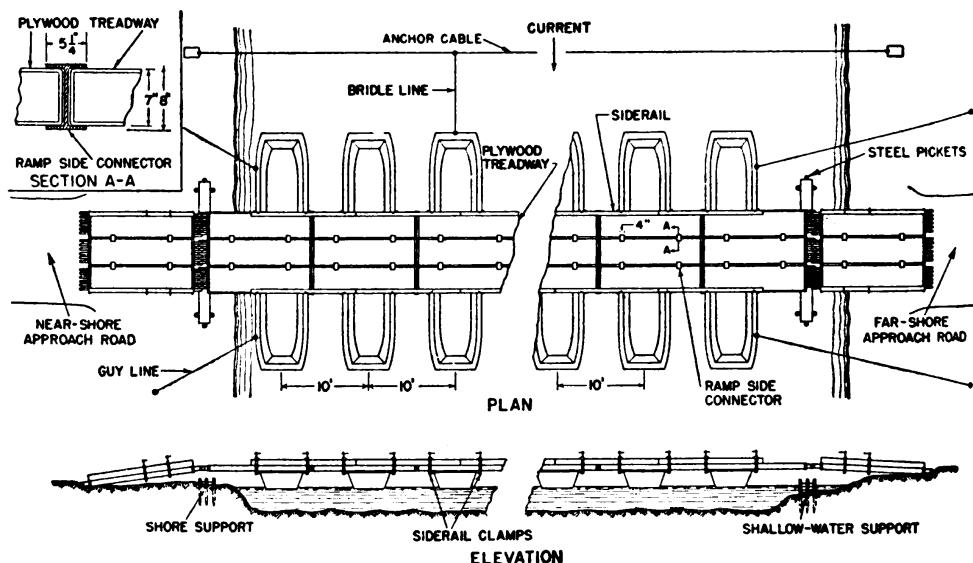


FIGURE 73. *Expedient assault-boat bridge with triple-treadway deck.*

(3) All siderails are placed on outside edges of outer treadways; siderail clamps are placed with screw part up.

(4) The outer treadway set of spacers on the pontons is used.

b. Organization. The organization for the triple-treadway bridge is the same as for construction of the double-treadway bridge with the following additions:

(1) The number of men in the treadway-carrying detail is increased to 24.

(2) One man is added to the river assembly detail; his duty is to place the ramp side connectors between adjacent treadways.

c. Abutment connection. The abutment connections are made in the same manner as in the double-treadway bridge. (See par. 80 and fig. 73.)

Section IX

Maintenance and Transportation of Equipage

82. BOATS. The care and maintenance of assault boats are covered in chapter 2.

83. PLYWOOD TREADWAYS. Treadways should be kept painted, dry, and well ventilated at all times when not in use. Holes of 3 inches or less in the sanded flooring of the treadways should be covered with sheet metal fastened with small nails. This prevents mud leaves from entering and causing the stringers inside the treadways to rot and decay. Treadways with larger holes should be replaced. A finger should be repaired in the shop, not in the field.

84. SIDERAISLS. Siderails should be cleaned, inspected, and painted before storing.

85. MOTORS. Dependable operation of outboard motors can be achieved by following the instructions contained in the manufacturer's instruction book. Men trained in the use of motors should be responsible for their operation and maintenance. The following points will aid in operating and maintaining outboard motors:

a. The specially built chests are provided and always must be used when transporting motors by truck. Motors must not be dropped, whether in chests or not. They should be covered when not in use.

b. Manufacturer's instructions regarding spark plugs and proper mixture of gasoline and oil are especially important and must be followed exactly.

c. Dirty or wet spark plugs frequently cause failure of an outboard motor to start or to operate properly. An operator always should carry at least one set of clean, dry spark plugs in his pocket as replacements.

d. Operators should be prohibited from disassembling motor, except for changing spark plugs, inserting spare parts, and removing and cleaning fuel-line screens. Other repairs should be made in shops under supervision of skilled mechanics.

e. Operator should be trained in replacing shear pin, damaged propeller, and other parts for which spares are furnished with the motor.

f. After use, motor should be drained of water while still vertical; this prevents water from entering cylinders through exhaust ports, causing rusting and hard starting later. Motor should be kept free of water, oil, and dirt.

86. MAINTENANCE OF BRIDGE. Siderail clamps should be tightened regularly. Treadway connecting pins at the joints should be inspected to see that the pins do not work out. Damaged equipage should be replaced. Alignment of the bridge should be maintained as required.

87. CLAMPS AND GUY LINES. The clamps and guy lines should be kept clean and dry. Provision should be made for cleaning, drying, and coiling the rope after use to prevent grit from working into and cutting the fibers. The screw parts of the clamps should not be lubricated, since lubrication leads to an accumulation of dirt and dust that causes more serious fouling and damage than does lack of lubrication.

88. TRANSPORTATION OF RAFT EQUIPAGE. Attachment of rafts to engineer units normally is in increments of six rafts together with two ferry sets (ch. 9) which are loaded on six 2½-ton trucks and six two-wheel utility trailers. A complete raft set is carried on one truck and one trailer, the latter carrying the six assault boats and six siderails. Treadways, outboard motor, and the remaining small parts of the raft are carried upon the truck. The two ferry sets can be carried on any two of the trucks. Assault boats may be carried upside down to prevent accumulation of water in them.

CHAPTER 8

EXPEDIENT RAFTS, CONSTRUCTED OF PNEUMATIC FLOATS AND PLYWOOD TREADWAYS

89. GENERAL DESIGN. Expedient rafts can be built of plywood treadways supported on 6- or 12-ton pneumatic floats. Various combinations of treadways and floats may be used depending on the amount of material available and the loads to be carried. To spread the load over the entire float on rafts using 6-ton floats, float sills are placed lengthwise on top of each tube; on rafts using 12-ton floats, wood saddles are placed across the floats and float sills are placed lengthwise on top of the two outer tubes. Siderail clamps connect the treadways to the float sills.

90. CAPACITY. a. Six-ton-float raft. A raft consisting of four 6-ton floats with double-treadway deck will carry a loaded $2\frac{1}{2}$ -ton truck (fig. 74).



FIGURE 74. *Expedient raft constructed of four 6-ton floats and three pairs of plywood treadways carrying a loaded $2\frac{1}{2}$ -ton truck.*

b. Twelve-ton float raft. A raft consisting of three 12-ton floats with triple-treadway deck will carry a loaded 4-ton truck safely in 3 feet per second current and, with caution, in 5 feet per second current.

91. COMPOSITION. **a. Six-ton-float raft** (fig. 75). A four-float, double-treadway raft requires the following:

- 4 six-ton pneumatic floats.
- 8 plywood treadways, six for decking and two for approach ramps.
- 12 float sills.
- 16 siderail clamps.
- 6 siderails.
- 16 lashings.
- 4 guy lines.

b. Twelve-ton-float raft (fig. 76). A three-float, triple-treadway raft requires the following:

- 3 twelve-ton pneumatic floats.
- 12 plywood treadways with ramp side connectors.
- 6 float sills.
- 18 wood saddles.
- 12 siderail clamps.
- 6 siderails.
- 12 lashings.
- 4 guy lines.

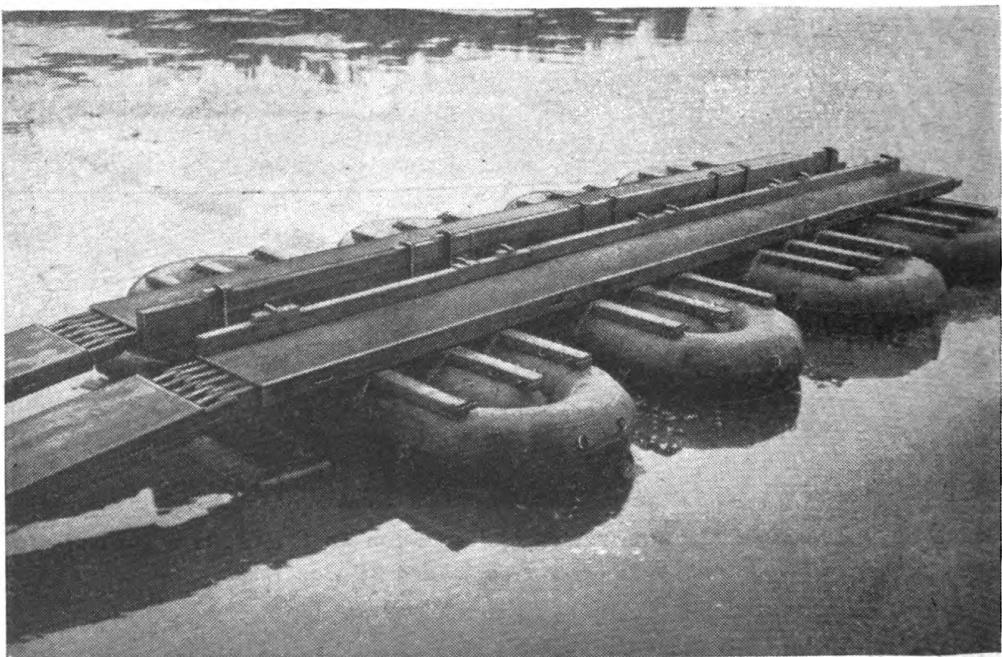


FIGURE 75. *Expedient raft built of 6-ton rafts with treadway support in place.*

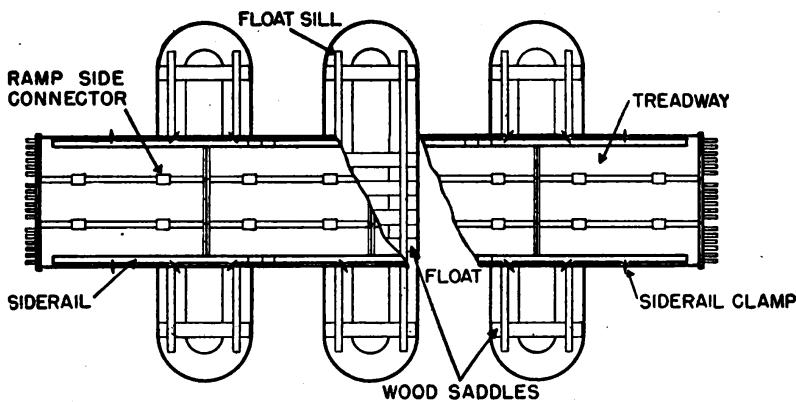


FIGURE 76. *Expedient raft built of three 12-ton floats with triple-treadway deck.*

92. DESCRIPTION OF EQUIPMENT. **a. Six-ton pneumatic float.** See paragraph 36.

- b. Twelve-ton pneumatic float.** See TM 5-275.
- c. Plywood treadway.** See paragraph 46.
- d. Float sills.** Trestle balk or chess of the 10-ton ponton equipage, wooden planks about 3 by 12 inches by 15 feet, or other suitable timbers.
- e. Wood saddles.** Planks about 3 by 12 inches by 7 feet.
- f. Siderail clamps.** Clamps of the 10-ton ponton equipage.
- g. Siderails.** Trestle balk of the 10-ton ponton equipage, siderails of the infantry-support-raft set, or other suitable timbers.
- h. Lashings.** Short lengths of rope used to lash clamps to the D-rings of the floats.

93. CONSTRUCTION. **a.** The construction procedure for a three-treadway raft made with four 6-ton floats is as follows:

- (1) An assembled float (fig. 77 or 78) is placed parallel to shore.
- (2) Two treadways are centered about $2\frac{1}{2}$ feet apart on float so their ends extend about 2 feet past riverward side of float.
- (3) Two more treadways are connected rigidly to the two in place, using treadway pins.
- (4) Shoreward ends of second pair of treadways are raised, and a second assembled float is inserted under them so connection of treadways is centered on second float.
- (5) Two more treadways are connected rigidly, their shoreward ends are raised, and a third assembled float is inserted as in (4) above.
- (6) Shoreward ends of the treadways again are raised, raft is pushed riverward, and a fourth assembled float is inserted beneath them so shoreward ends of treadways extend about 2 feet shoreward from fourth float.
- (7) Siderails are placed flush with inside edges of the treadways.
- (8) Siderail clamps are placed over siderail and under treadway. A small piece of lumber is placed on top of siderail so clamp may be tightened prop-

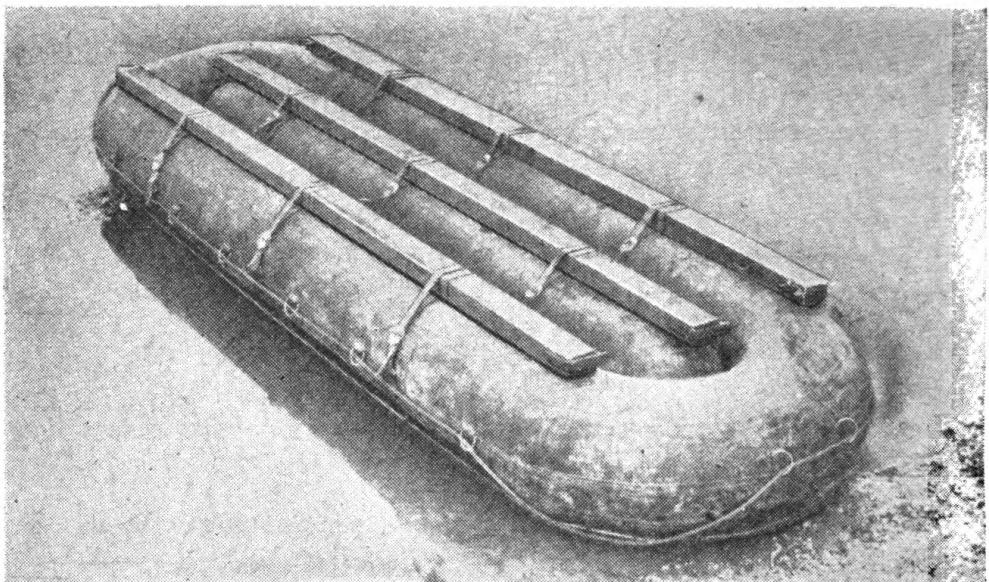


FIGURE 77. *Assembled 6-ton float with trestle balk as float sills.*



FIGURE 78. *Assembled 6-ton float with wooden planks as float sills.*

erly. Four clamps per float are used, placed handle down and directly over D-ring of float. A tight lashing then is made between the siderail clamp and D-ring (fig. 79).

(9) Guy lines, attached to both ends of riverward float at start of construction, are used to position raft as construction proceeds.

b. The above is a suggested construction procedure for a specific type expedient raft. It can be followed, in general, in building any expedient raft which employs pneumatic floats and plywood treadways. Because of

lack of an overhanging deck approach, ramps must be used with this type of raft. If the bank height is such that the overhang of the deck can rest on it, four pairs of plywood treadways should be used to provide an overhanging deck.

94. WORKING PARTY. A suggested working party for the construction of an expedient pneumatic-float and plywood-treadway raft is shown in table VII.

TABLE VII. *Organization of working party*

Detail	Non-commissioned officers	Enlisted men	Duties
Float-carrying.....	1	8	Carries floats to inflation site. After floats are inflated and assembled, carries them to raft site.
Treadway-carrying.....	1	16	Carries treadways to raft site and places them on floats. Assists river-assembly detail in connecting treadways.
Float-inflation.....	1	4	Inflates floats. Then carries and places siderails and siderail clamps.
Float-assembly.....	1	4	Places float sills and wood saddles (on 12-ton floats), and secures them with float-sill straps. When last float is assembled, carries and places siderails and siderail clamps.
River-assembly.....	1	4	Receives floats and treadways from carrying details and places them in position. Connects treadways with treadway-connecting pins and installs ramp side connectors (on triple-deck rafts). Attaches lashings between siderail clamps and D-rings.
Guy-line.....		2	Attaches guy lines to riverward floats and holds raft in position during construction.
Total.....	5	38	

95. PROPULSION. An expedient pneumatic-float, plywood-treadway raft can be propelled by an assault boat with an outboard motor attached, or by a power boat.

96. LOADING AND UNLOADING. See paragraph 71.

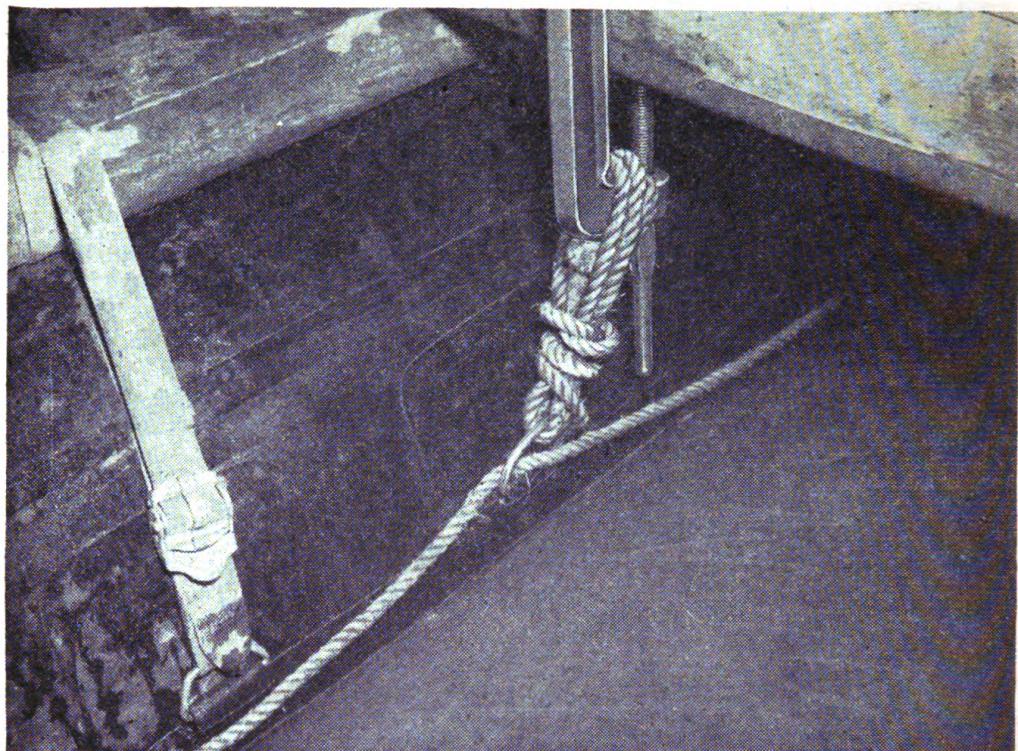


FIGURE 79. *Close-up of lashing between siderail clamp and D-ring.*

CHAPTER 9

INFANTRY-SUPPORT FERRY SET NO. 1

97. PURPOSE. The ferry set provides materials for construction of cable ferries to propel rafts across streams.

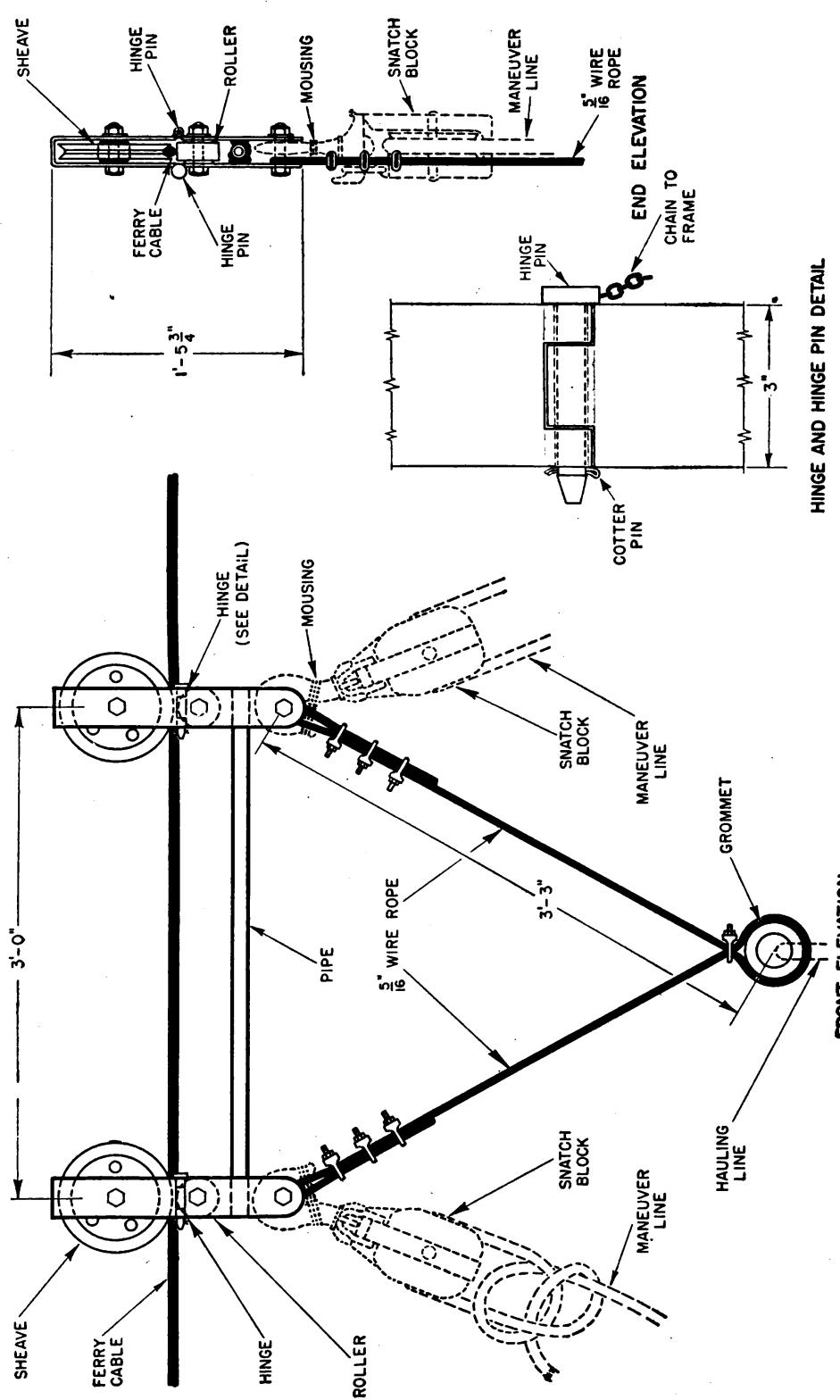
98. COMPOSITION AND ASSIGNMENT. **a. Composition.** The equipment in the ferry set is listed in table VIII.

TABLE VIII. *Infantry-support ferry set No. 1*

Equipment	Quantity
Ax, hand	2.
Block, snatch, for $\frac{7}{8}$ -inch manila rope	5.
Chest, miscellaneous bridge parts	1.
Clip, wire rope, steel, $\frac{1}{8}$ -inch	40.
Grip, cable, $\frac{1}{2}$ -inch wire rope	3.
Hoist, chain, ratchet, $1\frac{1}{2}$ - to 3-ton capacity	2.
Rope, manila, 1-inch	200 feet.
Rope, manila, $\frac{3}{4}$ -inch	600 feet.
Rope, wire, $\frac{1}{2}$ -inch, 6 by 19	600 feet.
Traveler, bicycle	1.
Traveler, spare parts:	
$\frac{1}{8}$ -inch grease fittings, Zerk type	6.
8-inch sheaves	2.
Wrench, adjustable, crescent type	3.

b. Assignment. See appropriate Tables of Equipment and FM 5-35.

99. DESCRIPTION OF EQUIPAGE. **a. Bicycle traveler.** The bicycle traveler (fig. 80) permits a raft to move smoothly along a ferry cable. It is a frame consisting of two housings with an 8-inch sheave mounted in each, the housings being separated by a length of $1\frac{1}{4}$ -inch pipe. A wire cable runs from the housings to a grommet as shown in figure 80. The housings have a double-hinge connection to enable the ferry cable to be inserted. Two hinge pins, held in place by cotter pins, prevent the hinge connection from coming apart. Moused snatch blocks are attached to the sheave housings and maneuver lines are run through them. The hauling line is attached to the grommet.



FRONT ELEVATION FIGURE 80. *Bicycle traveler.*

b. Other parts of equipment. (1) The other parts in the ferry set are rigging equipment.

(2) They are used as follows:

(a) Hand axes—to cut the hauling rope quickly to allow a raft to float free from a ferry cable if the raft is in danger of swamping in a swift current.

(b) Ratchet chain hoists—from time to time to take excess sag out of the ferry cable as it stretches.

(c) One-inch manila rope—for ferry hauling lines; $\frac{1}{2}$ -inch manila rope—for ferry maneuver lines.

(d) Wire rope—for the ferry cable.

(e) Wire rope clips and cable clips—on the ferry cable.

(f) Snatch blocks—on the bicycle traveler (fig. 80) and also for general utility.

(g) Crescent wrenches—to tighten the wire rope clips.

100. TRAIL FERRY. a. The trail ferry principle may be used to propel rafts where the current exceeds 2 miles per hour.

b. The trail ferry is rigged as follows: A ferry cable is stretched across the stream and made fast to deadmen or natural hold-fasts. When necessary, the cable may be elevated by passing it over an A-frame erected on each bank. Sag is taken out of it by the ratchet chain hoists. The bicycle traveler is attached to the cable so its sheaves roll smoothly. The hauling line is attached to the grommet, and the maneuver lines to the snatch blocks which are attached to the sheave housings of the traveler. Both run to the upstream portions of the raft. Figure 81 shows a five-assault-boat ponton raft as a trail ferry.

c. The trail ferry is operated as follows: By means of the maneuver lines the raft is turned at an angle to the current so the upstream ends of the pontoons incline toward the opposite shore. The current pushes against the upstream sides of the pontoons and forces the raft across the stream, the bicycle traveler running on the cable. Speed of the raft increases as its pontoons are pointed into the current up to about 45° .

101. FLYING FERRY. The flying ferry works on the same principle as the trail ferry except the raft is held in the stream by an anchor well upstream from the crossing site. (See fig. 82.) If the current is strongest near one shore the anchorage must be near the opposite shore; if the current is uniform the anchorage should be in midstream. The length of the cable must be at least $1\frac{1}{2}$ times the width of the stream. Floats support the cable clear of the water. The cable is made fast to the raft at its center, and maneuvering ropes for changing the raft's direction are made fast to the cable. As the raft moves from shore to shore, it swings in the arc of a circle the center of which is the anchor. The flying ferry requires a current velocity of at least $2\frac{1}{2}$ miles per hour throughout its path.

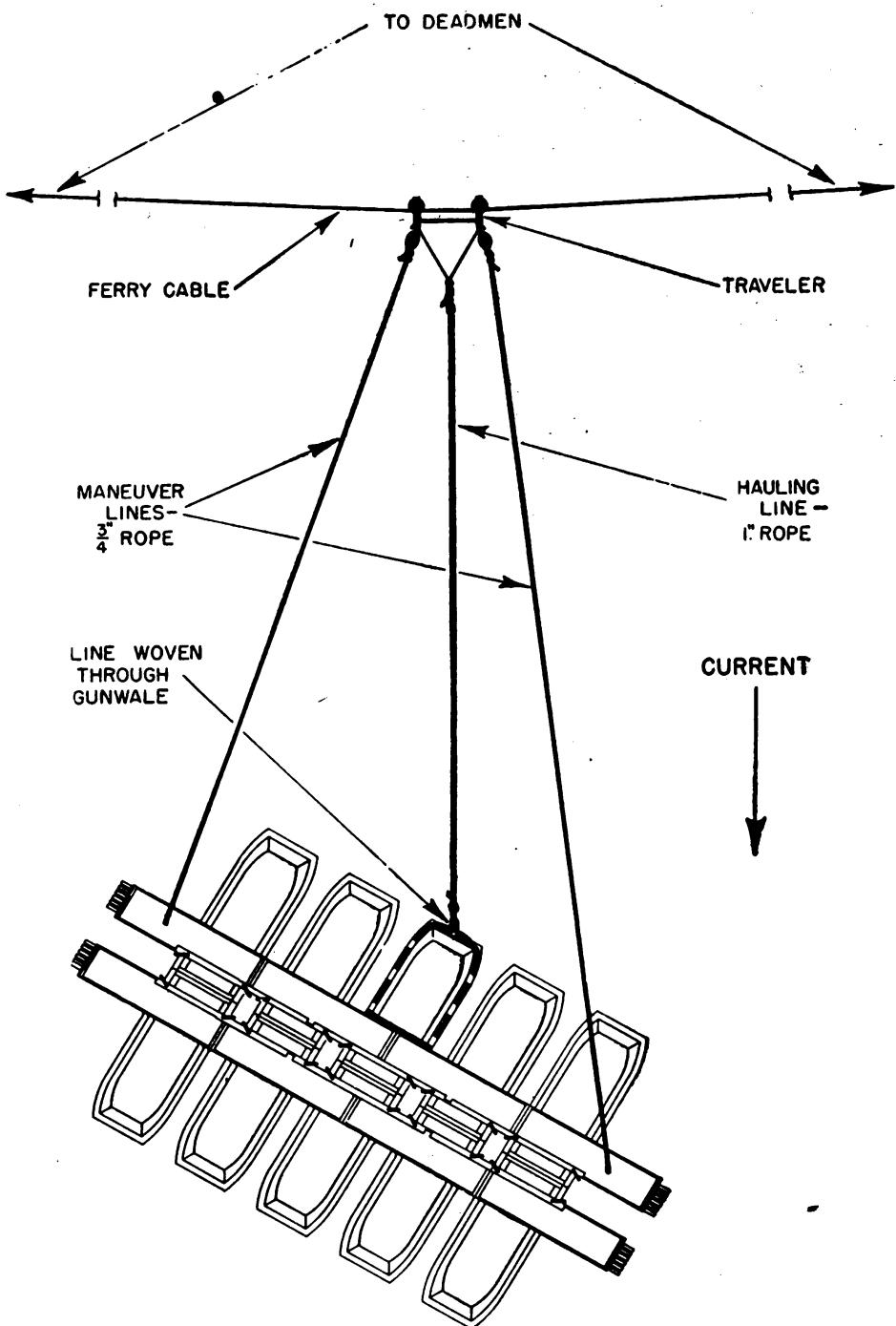


FIGURE 81. Rigging for a five-assault-boat ponton raft used as a trail ferry.

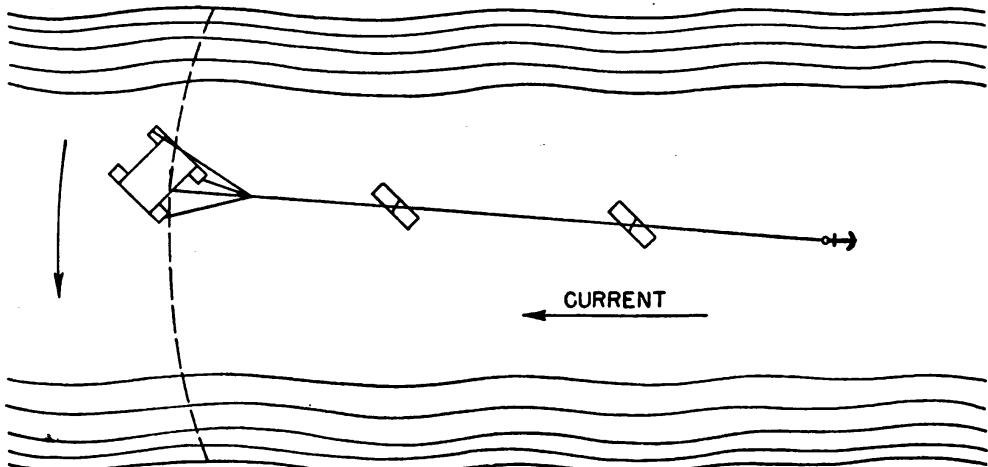


FIGURE 82. *Lay-out for flying ferry.*

102. OTHER MEANS OF PROPULSION. The outboard motor may be used in conjunction with the trail ferry or flying ferry to add speed and to prevent downstream drift. Outboard motors alone may be used if the current is not sufficient for self-propelled ferries; or in slight currents the ferry may be pulled by ropes.

CHAPTER 10

FOOTBRIDGE M1938

Section I General

103. PURPOSE. The footbridge is used for rapid passage of foot troops across a stream. When reinforced it will also carry 37-mm antitank guns.

104. TRAFFIC CAPACITY. a. In currents up to 3 feet per second. About 75 men per minute can cross the bridge in daylight and 40 men per minute in blackout. Men cross at double time (fig. 83) and at intervals of about 2 paces. Too great concentration of loads on the bridge will cause a portion of it to submerge. A column continues at double time until it has cleared the bridge.

b. In currents above 3 feet per second. The footbridge is safe in currents up to 7 feet per second. At that velocity an interval of two bays must be maintained between individuals crossing the bridge; at 5 feet per second, one-bay intervals are sufficient.

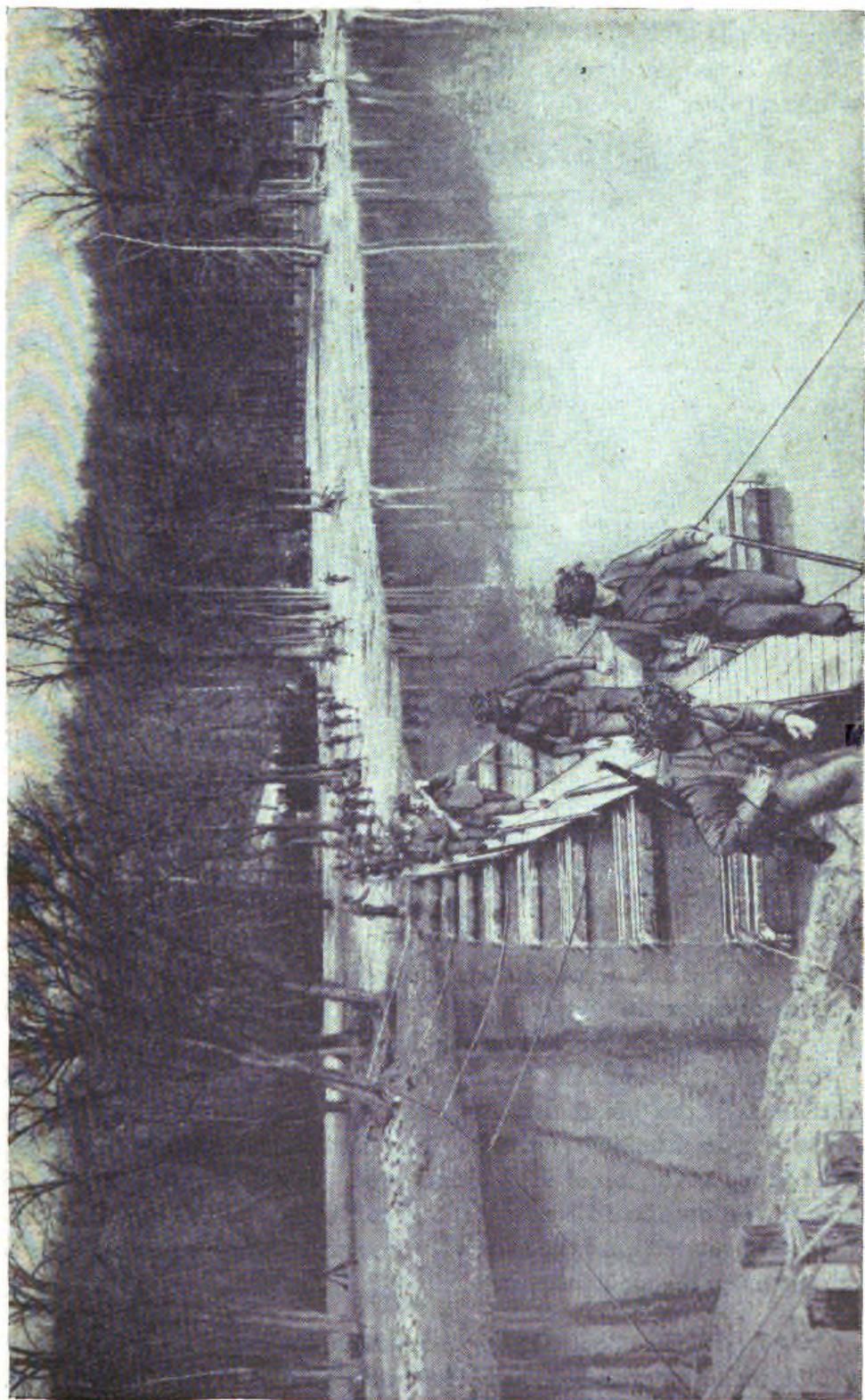
105. COMPOSITION AND ASSIGNMENT OF EQUIPAGE. a. Composition. Table IX gives the component parts of a unit (432 feet) of foot-bridge.

TABLE IX. *Footbridge M1938 set*

Article	Quantity
Clip, wire rope, $\frac{3}{8}$ -inch.....	24
Coupler, stringer, female (spares).....	6
Coupler, stringer, male (spares).....	3
Duckboard, 12-foot.....	36
Fastener, duckboard, steel (spares).....	6
Float, footbridge, complete.....	72
Hook, boat, ball point, 10-foot.....	2
Picket, steel.....	32
Post, handrail, steel.....	80
Rope, manila, $\frac{1}{2}$ -inch, 30-foot lengths (bridle lines).....	36
Rope, manila, $\frac{1}{2}$ -inch, 500-foot lengths (handrail lines).....	2
Rope, manila, $\frac{1}{2}$ -inch, 750-foot lengths (guy lines).....	2
Rope, wire, $\frac{3}{8}$ -inch, galvanized, 6 by 37, 600-foot lengths with reel (float and anchor cables).....	4
Snap, harness, round-eye (2 on each bridle line).....	72
Spring, coupler, steel (spares).....	6

b. Assignment. See appropriate Tables of Equipment and FM 5-35.

FIGURE 83. *Troops crossing footbridge.*



106. WORKING PARTY AND TIME REQUIRED. **a.** The bridge normally is constructed by an engineer platoon. For organization of working party, see paragraph 111.

b. Table X gives estimated times required to construct the normal and the reinforced (sec. V) footbridges.

TABLE X. *Estimated construction times for footbridge*

Length of bridge	Time in minutes ¹			
	Normal construction		Reinforced construction	
	Staff-planning purposes ²	Training purposes ³	Staff-planning purposes ²	Training purposes ³
72.....	5	3	30	15
144.....	10	6	60	30
288.....	20	12	.....	.....
432.....	30	18	.....	.....

¹ Times given are for equipment stacked at site. They include time necessary to place guy lines (when used) and float cables; they do not include time necessary to place anchor cables which varies with site and stream conditions and availability of hold-fasts. Times are for daylight construction; increase 50 percent for blackout.

² Staff-planning times allow time for unpredictable delays usually encountered in tactical constructions.

³ Training times assume trained personnel, favorable weather and site conditions, and no delays.

Section II

Description of Equipage

107. DUCKBOARD. **a.** The duckboard (fig. 84), weighing approximately 100 pounds, is made of white pine and consists of a series of transverse slats 1 by 7 by 22 inches mounted on two stringers 1 5/8 by 4 1/2 inches by 12 feet. Its floor surface is covered with skidproof paint. Each end of the duckboard (fig. 85) has a male and a female fitting for attaching the duckboard to adjacent duckboards. Spacer blocks are placed beneath the duckboard stringers to locate the duckboard on the floats.

b. To connect duckboards, force the wedge-shaped male fastening between the lugs of the female fastening until they snap into the holes in the sides of the male fastening (fig. 86). The fastenings may be uncoupled, using the fitting at the top of the handrail post. The fitting is inserted into the hole in the duckboard slat or crosspiece directly behind each female fastening, and rotated until the leaves of the female fastener are pried open enough to release the male fastening.

108. FLOAT. **a.** The float (fig. 87) is a white-pine crate 10 feet long and 10 by 13 1/2 inches in cross section. The crate contains layers of expanded rubber, the displacement of which gives buoyancy to the float. The float weighs approximately 85 pounds and will support 400 pounds.

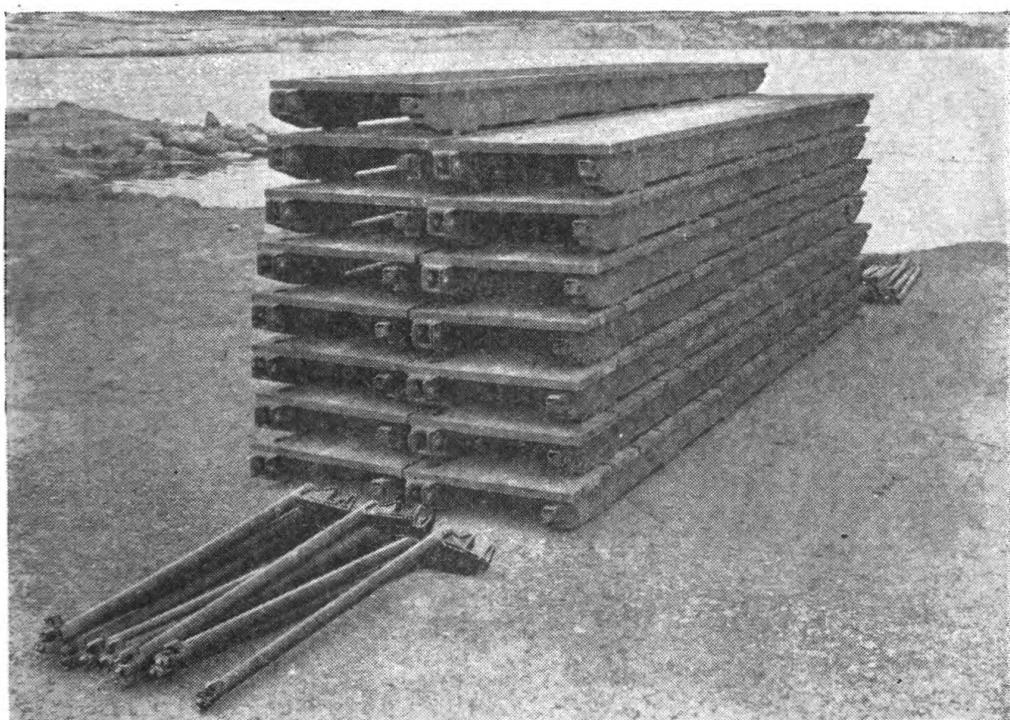


FIGURE 84. Duckboards and handrail posts.

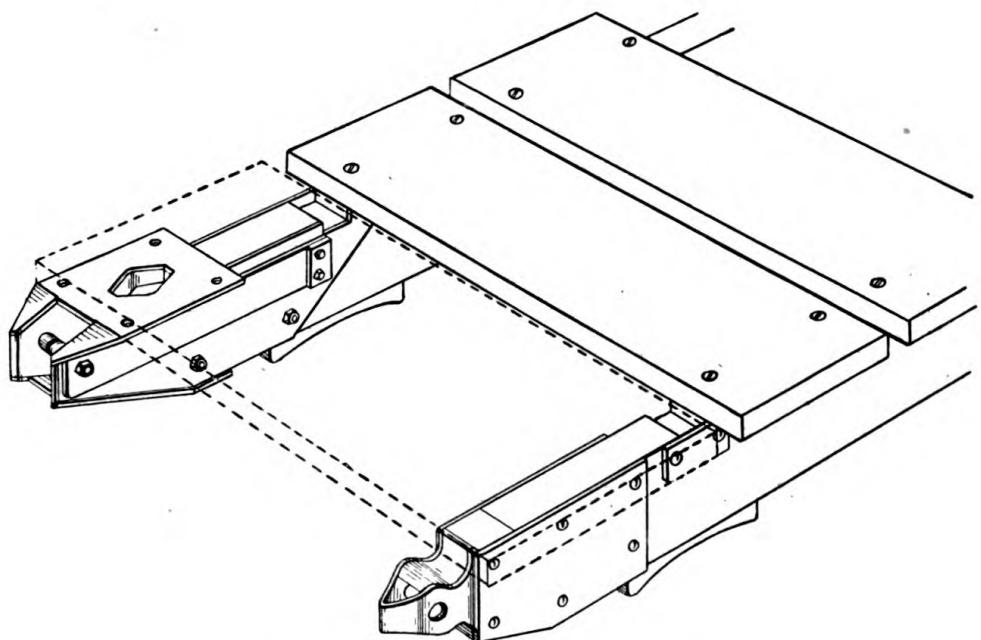


FIGURE 85. Duckboard connectors.

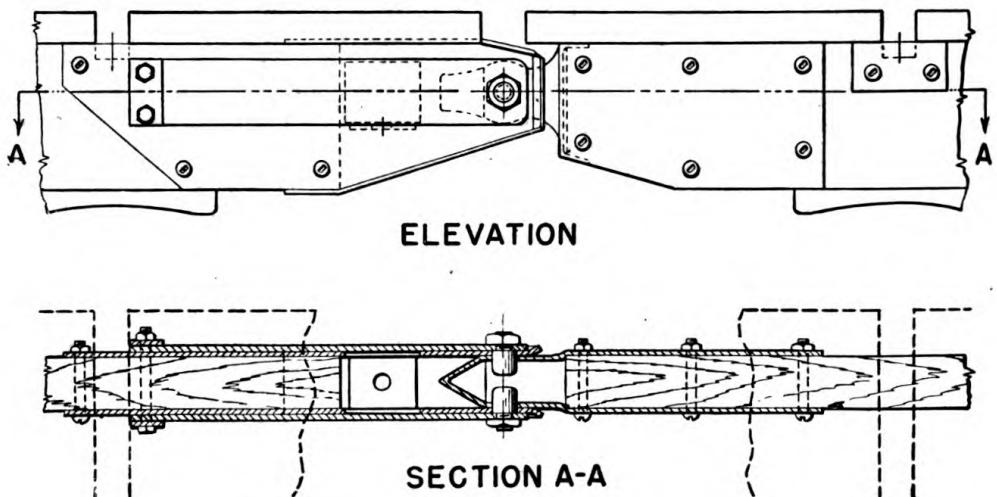


FIGURE 86. Duckboard connectors, latched.

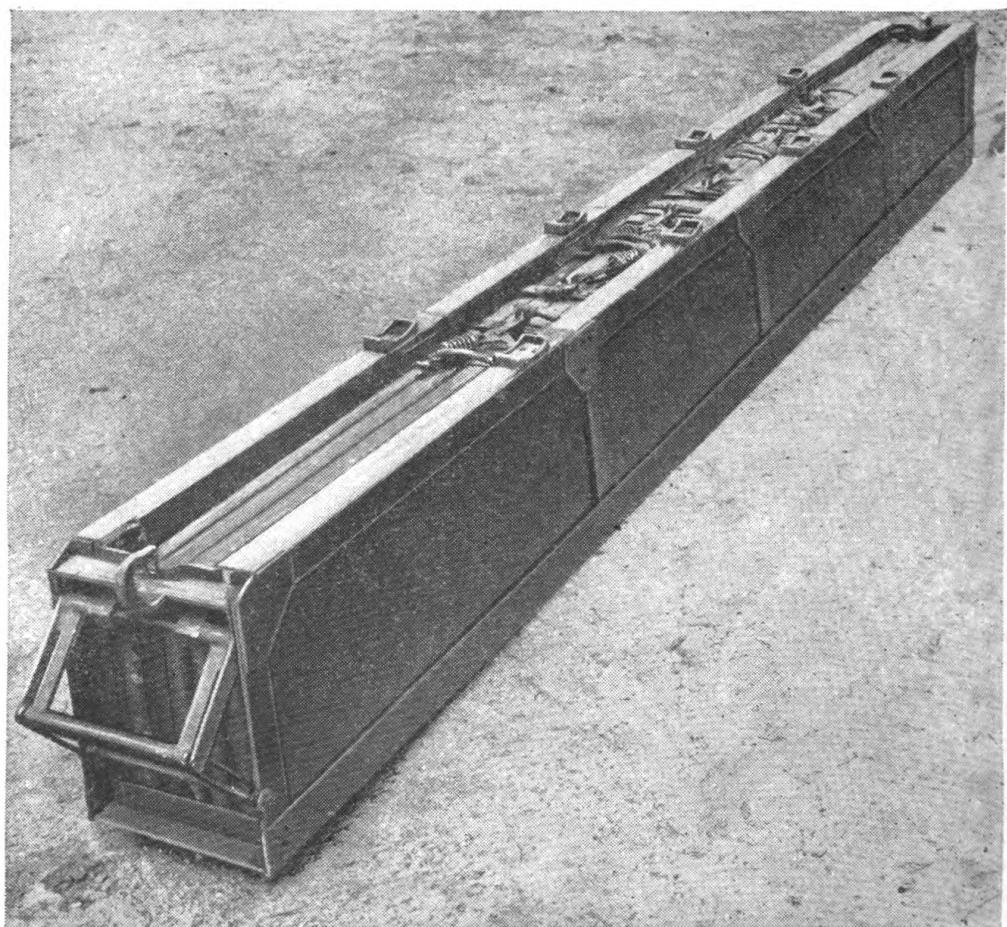


FIGURE 87. Float.

- b. At each end of the float is a folding carrying handle, and a hook for the float cable attachment.
- c. On top of each float are three pairs of spring-tightened hooks to attach the float to the duckboard or duckboards.
- d. To connect the float to the duckboard, the duckboard is placed on it and the spring fasteners on both sides of the duckboard are lifted and hooked over the duckboard stringers. The handles of the hooks then are moved clear of the footway. (See figs. 88 and 89.)

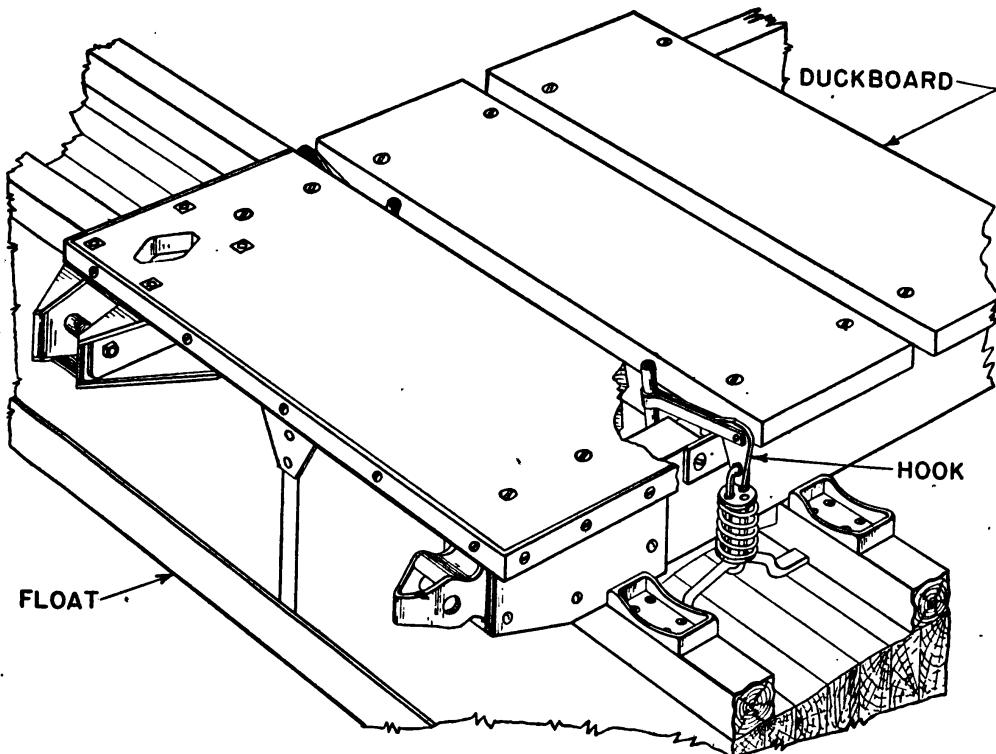


FIGURE 88. *Float attached to duckboard.*

109. HANDRAIL POST. The aluminum handrail post (fig. 84) has a bronze fitting at the top which serves as a receiver for the handrail line and also as a tool to disengage the duckboard fasteners. The post is attached to the duckboard stringer by means of a slot in the bottom of the post. Two posts per bay are used, one on each side of the duckboard.

110. CABLES AND LINES. The anchor cable and bridle lines are used to guide the bridge during construction, to aid in aligning it after construction, and to hold it in final position. Guy lines are used for the same purposes when the bridge is built in still water. The float cable, attached to the upstream side, prevents swift currents submerging and overturning the footbridge while it is in use.

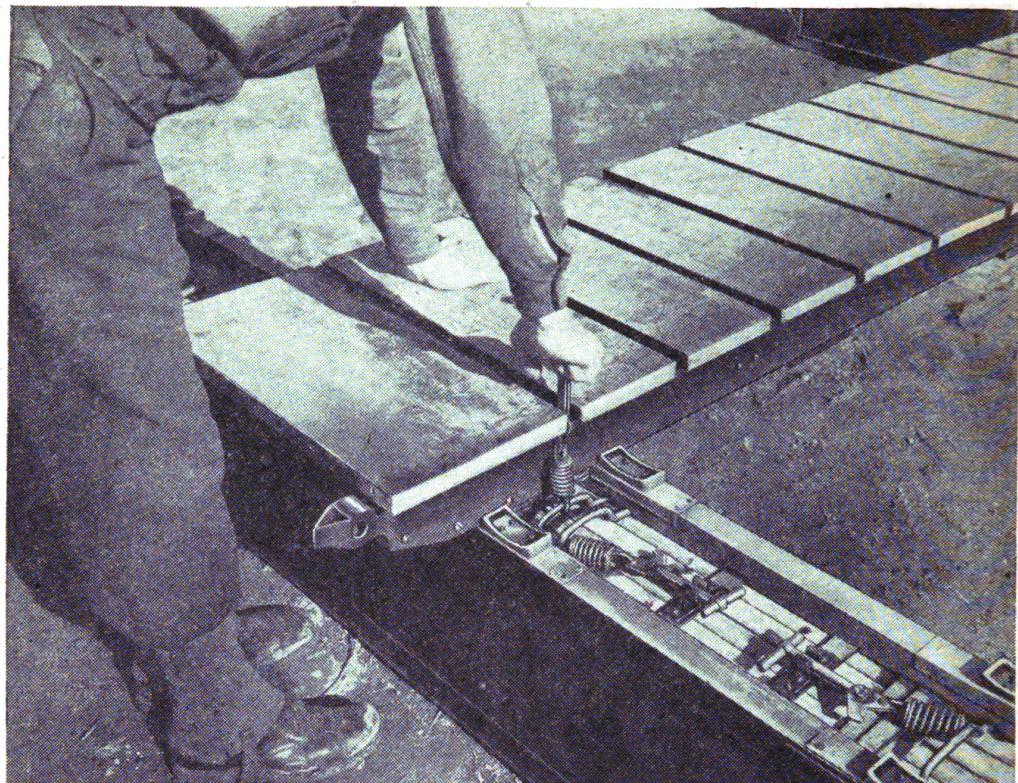


FIGURE 89. *Fastening duckboard to float.*

Section III Working Party

111. ORGANIZATION AND DUTIES OF WORKING PARTY. *a.* Bridge construction is under the supervision of an officer. Supply of bridge materials to the site should be controlled by a second officer or a noncommissioned officer.

b. The working party required for the construction of the footbridge consists of near- and far-shore anchor-cable, bridle-line, guy-line, shore-assembly, assembly-carrying, river-assembly, handrail-line, and float-cable details. Table XI gives a suggested organization of a working party, with the duties of details.

TABLE XI. *Organization of working party and duties of details*

Detail	Noncom-missioned officers	Enlisted men	Duties
(1) Near-shore anchor-cable.	.....	4.....	(1) Carry near-shore hold-fast materials to site designated by noncommissioned officer. Receive and hold end of anchor cable from far-shore detail. Prepare hold-fast. Tighten and fasten shore end of cable upon order of noncommissioned officer. Assist assembly-carrying detail to carry assembled bays.
(2) Far-shore anchor-cable.	1.....	6.....	(2) (a) Procure, launch, and load assault boat with anchor cable and materials for preparing far-shore anchor cable hold-fast. (Materials for preparing far-shore float cable hold-fast are also loaded when float cable is used.) (b) Pass free end of anchor cable to near-shore detail. Paddle to far shore while cable is payed out from boat. (c) Prepare far-shore anchor-cable hold-fast; attach cable to hold-fast and signal near-shore detail to tighten cable. (d) Signal near-shore assembly detail when end of bridge is two bays from far shore. (e) As first bay reaches shore, remove shoreward float and fasten duckboard in place. (Float cable is attached to prepared hold-fast and near-shore detail signaled to tighten cable, when cable is used.) Make bridge fast to far shore.
(3) Bridle-line.....	1.....	1 per line..	(3) Prepare and attach bridle-lines to centers of duckboards as directed. Each line is attached to anchor cable and then handled by one man. One man is located on far end of completed portion of bridge and remainder are spaced with their lines at proper intervals as bridge is assembled. Alignment of bridge is maintained by handling of lines as bridge moves across river. As soon as bridge reaches far shore, final alignment is made and bridle-lines made fast to duckboards. Men then move to near shore.
(4) Guy-line.....	1	2 per line...	(4) (a) Attach upstream and downstream guy lines to first bay of bridge. Two men per line handle lines to align and direct movement of bridge across waterway. Align bridge and fasten lines. (b) Two men per line attach upstream and downstream lines to duckboards of other bays of bridge. Align bridge and fasten lines. Place pickets for fastening all guy lines to shore.

TABLE XI. *Organization of working party and duties of details—Continued*

Detail	Noncom-missioned officers	Enlisted men	Duties
(5) Shore-assembly...	1	8	(5) Procure materials and assemble floats to duckboards. Two men handle each float and two each duckboard; two place handrails; total men. Prepare template for aligning floats so duckboard may be quickly placed and hooked. Noncommissioned officer directs work. Place two floats in template, place duckboard with handrail posts on floats, fasten float clamps, and release to assembly-carrying detail.
(6) Assembly-carrying.	1	4.....	(6) One man at each end of two floats carry assembled single bay from shore-assembly site to shoreward end of completed section of bridge. Launch bay and release to river-assembly detail.
(7) River-assembly	1	6.....	(7) Four men receive bay from assembly carrying detail, move bay to near shore end of bridge, and couple new bay to completed portion of bridge by engaging male and female duckboard fittings. Two men hold completed portion of bridge and assist in making connection. Noncommissioned officer kneels on end of bridge and assists. All six men push bridge out length of added bay.
(8) Handrail-line.....		3.....	(8) One man of handrail detail makes lines fast to river end of first duckboard and then takes post on bridge near in-shore end and threads handrail lines through handrail posts on each side as bridge is pushed out. Two men remain on near shore, one upstream and one downstream from bridge, to pay out lines and make them fast to pickets on near shore when bridge is completed.
(9) Float-cable.....		4.....	(9) (a) Carry float cable and near-shore hold-fast materials to point designated by noncommissioned officer of anchorable detail. (b) One man prepares float cable hold-fast on near shore; two men prepare support for cable reel and pay out cable; one man attaches free end of cable to first duckboard and places cable in hook at upstream end of each float except first float of bridge

Section IV

Construction

112. SITE REQUIREMENTS. The site requirements are similar to those for other floating bridges. Tactical requirements of sites are given in FM 5-6.

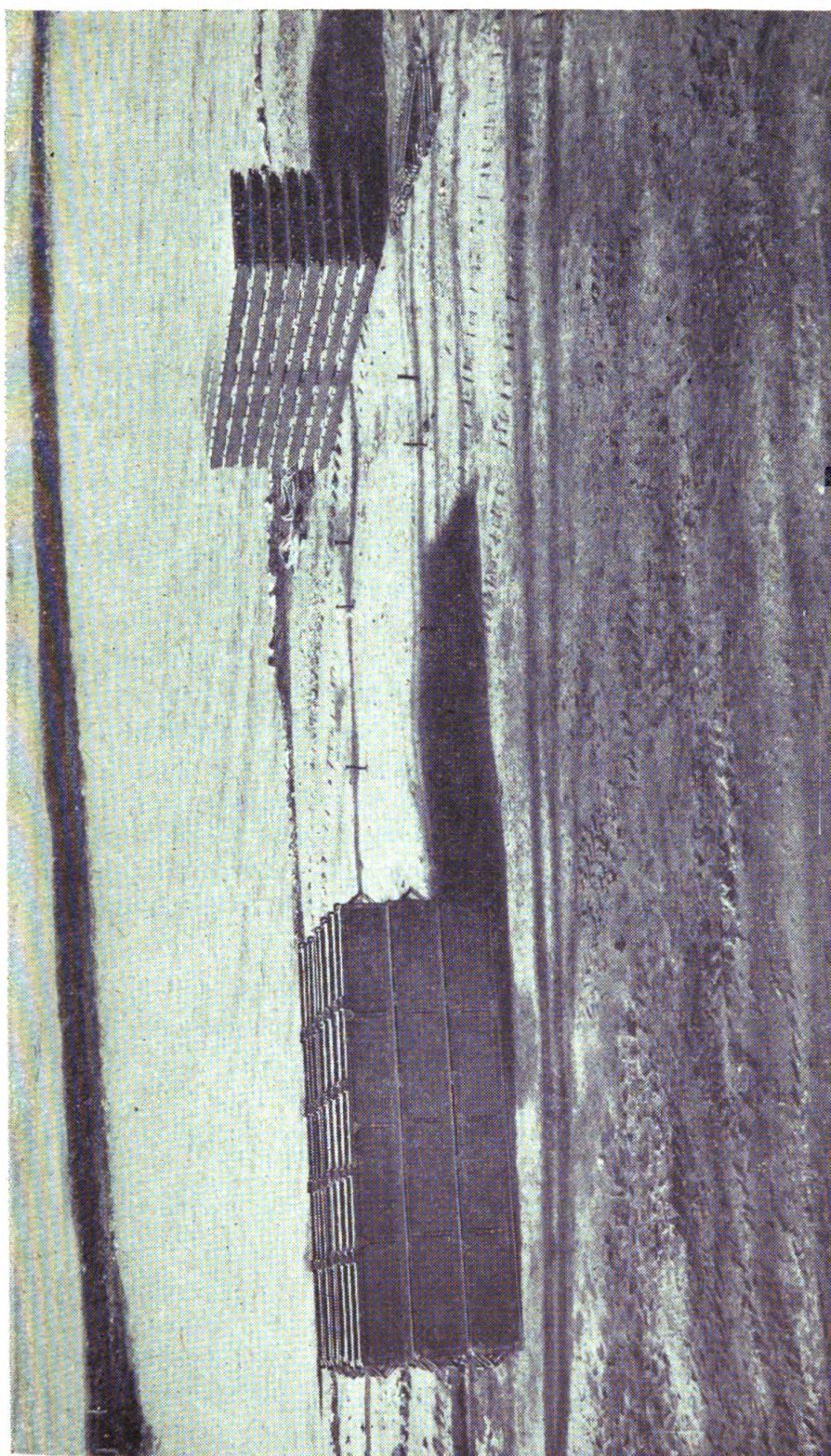


FIGURE 90. *Floats and duckboards stacked at site.*

- a.** The bridge should be on a road, path, or other cleared approach that will facilitate carrying the bridge equipment to the site and permit rapid movement of foot troops across the bridge.
- b.** A small cleared area on the near shore large enough for shore assembly of bridge parts facilitates construction (fig. 90).
- c.** Preferably, the stream bottom at the site should be firm and should slope so water about 6 inches deep is reached 2 or 3 feet from the shore. It is preferable that water within 20 to 30 feet from shore not be over waist deep.
- d.** These ideal site conditions are seldom found; the time of construction is increased when they are not fulfilled.

113. METHODS OF CONSTRUCTION. **a. By successive bays.** The normal method of construction is by successive bays. A bay consists of one duckboard, two floats, and two handrail posts. Single bays are assembled successively on shore, carried into the water, and connected to the near-shore end of the completed portion of the bridge which then is moved the length of one bay farther across the stream so the next bay may be floated and connected. Anchor cables and bridle lines, or guy lines, may be used with this type construction.

b. By sections. Two or more bays are assembled on shore, launched, and attached as a unit to the shore end of the completed portion. This method requires more men, more time, and closer supervision of working parties than construction by successive bays.

c. Land assembly and launching as a unit. To span a narrow and sluggish waterway the entire bridge may be constructed completely on shore, picked up as a unit, carried into the water, and pushed across. This method is impracticable when there are steep banks, brush, trees, or rough ground at the bridge site.

114. MOVEMENT OF MATERIALS TO BRIDGE SITE. **a.** The footbridge equipment is brought forward in trucks to a point not far from the waterway and hand-carried to the site. Equipment should arrive at the shore-assembly site in the following order: cables, ropes, accessories, tools, duckboards, floats, and handrails. Carrying parties should be loaded and dispatched in that order.

b. For less than 300-yard hand carries, the loads should be distributed as follows:

Duckboard-----	2 men.
Float-----	2 men.
Pickets, steel-----	4 per man.
Handrail posts-----	6 per man.
Bridle lines, 30-foot-----	15 to 20 per man.
Handrail lines, 500-foot-----	1 per man.
Guy line, 750-foot-----	2 men.

Float cable, 600-foot-----	4 men.
Anchor cable, 600-foot-----	4 men.
Extra assault boat (from ponton unit) -----	10 men.

About 260 men are required to carry an entire unit of the bridge at one time.

c. As materials arrive at the site, equipment should be stacked in convenient order. Materials for anchor cables and hold-fasts are prepared immediately. Floats are placed at one side of the template and duckboards and handrail posts on the other. When sufficient space is not available at the construction site, materials may be stacked a short distance from it and carried up as needed.

115. CONSTRUCTION PROCEDURE. a. **Officer in charge.** The officer or noncommissioned officer in charge of construction—

- (1) Has working details formed.
- (2) Says whether anchor cables or guy lines are to be used.
- (3) Designates points where upstream ends of floats enter water at near shore and leave water on far shore.
- (4) After detail leaders instruct their details, gives command: CONSTRUCT BRIDGE.
- (5) Exercises general supervision over all parts of work.

b. **Use of anchor cables and bridle lines.** (f) ANCHOR CABLE.
 (a) The anchor cable (fig. 91), always is used except when there is little current, is placed upstream from the bridge and secured before bridge construction begins. Anchor-cable detail carries assault boat, obtained from ponton unit, and necessary materials to point upstream where cable is to cross. Boat is loaded with anchor cable on its reel, a stick on which reel may turn, pickets, lashings, and sledges.

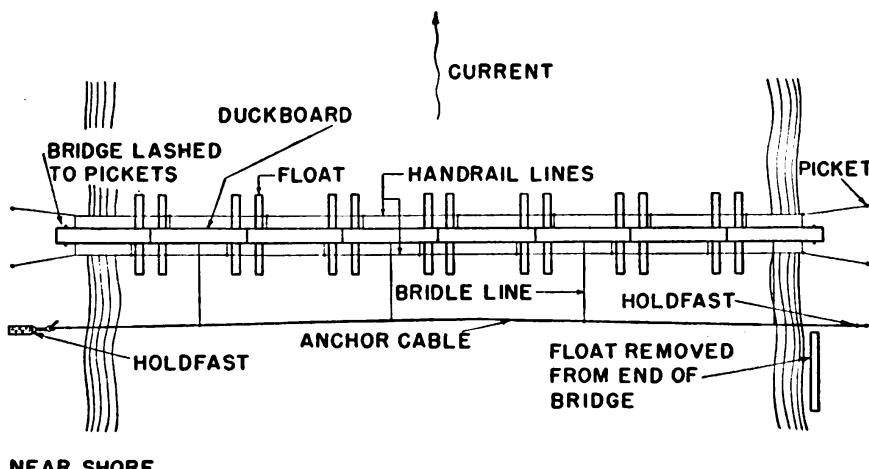


FIGURE 91. Use of anchor cable.



FIGURE 92. *Anchor cable being carried across stream in assault boat.*

(b) The four men of near-shore part of detail remain ashore to hold end of anchor cable while it is being unreeled from boat, to prepare a hold-fast when a suitable one does not exist, and to secure cable to hold-fast. Noncommissioned officer and far-shore detail of six men paddle across stream (fig. 92). Two men hold reel in center of boat and allow cable to unreel as boat crosses. Noncommissioned officer steers and the remaining men paddle. Boat is unloaded at far shore. Noncommissioned officer utilizes a natural hold-fast (tree or stump) for the anchor cable if one is available; otherwise, he directs installation of a prepared hold-fast. Anchor cable then is made fast and near-shore group ordered to tighten it.

(2) BRIDLE LINE. (a) Bridle lines are attached between anchor cable and duckboards, their number varying with stream velocity. In fast currents anchor cable is kept high and bridle lines passed under float cable, tending to elevate upstream ends of floats.

(b) Bridge alignment is maintained by bridle lines during construction. In fast currents riverward bridle lines are lengthened during construction, so upstream ends of floats incline toward far shore and current assists movement of bridge across stream. When bridge is completed, lengthened bridle lines are shortened to align bridge and bridle lines are made fast to duckboards (fig. 93).

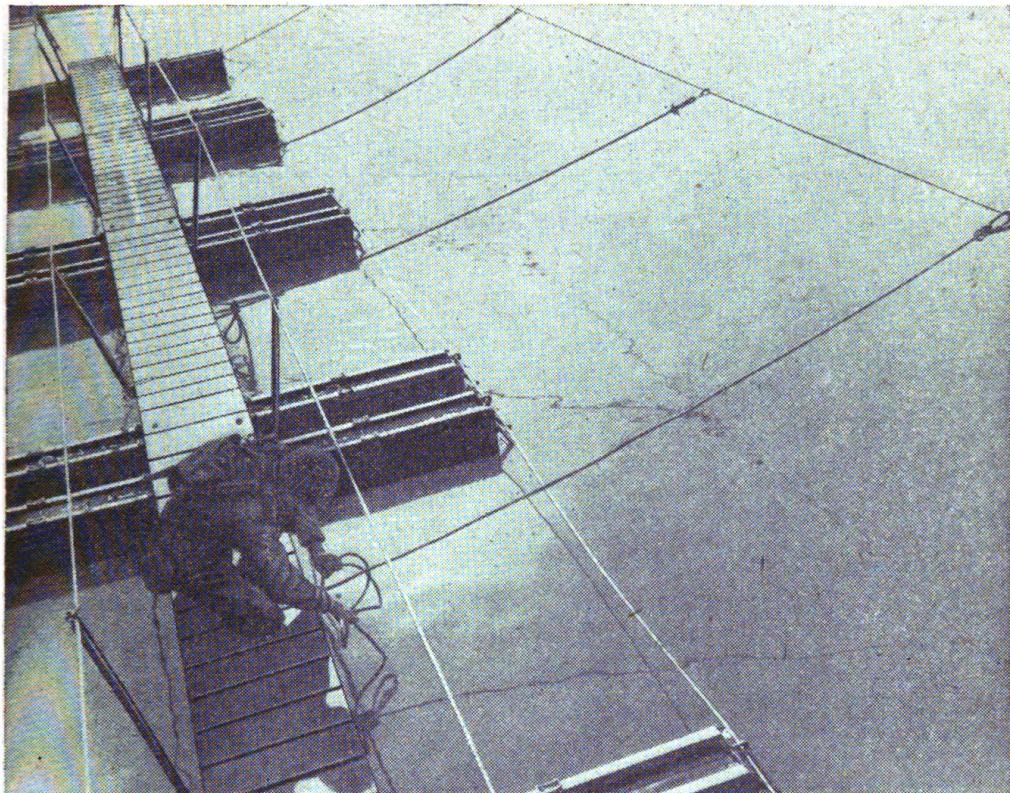


FIGURE 93. Adjustment of bridle lines (float cable in place).

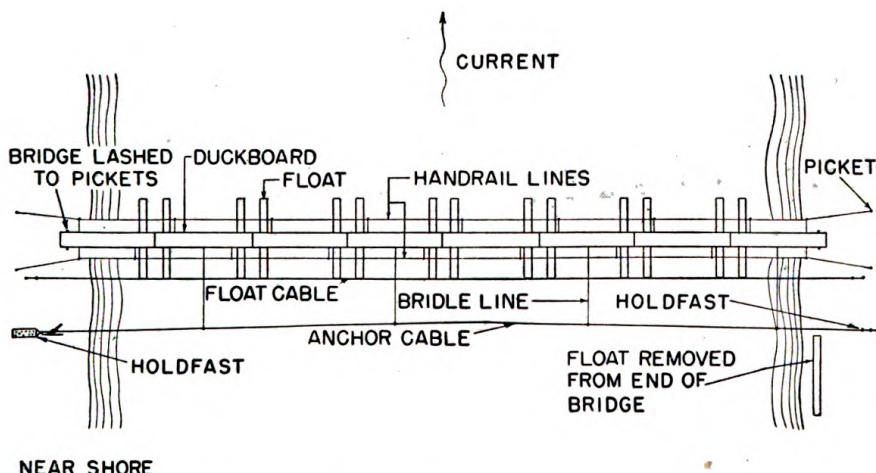


FIGURE 94. Use of float cable and anchor cable.

c. Use of float cables. When a float cable (fig. 94) is used, anchorable details prepare hold-fasts for it on both shores. Cable is payed out from near shore and far end is attached in hook at upstream end of each float (fig. 95) except the first.

d. Guy lines. Guy lines, attached while bridge is under construction, are used to guide bridge across waterways with little current. Noncom-

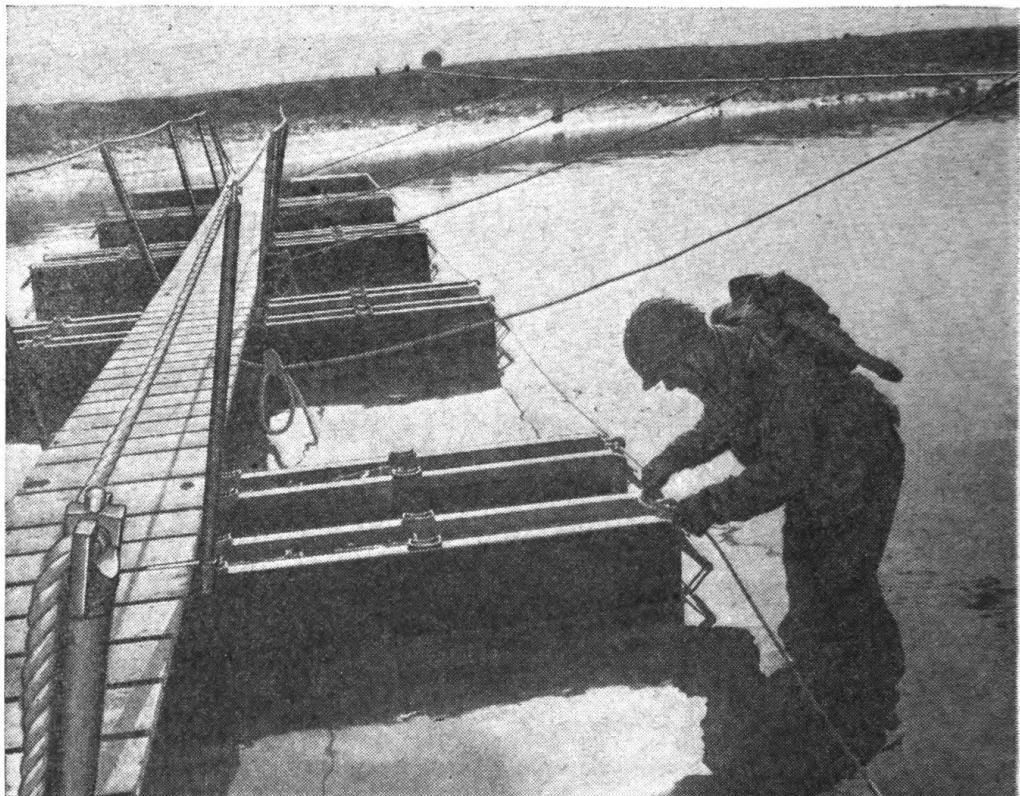


FIGURE 95. *Attaching float cable to float.*

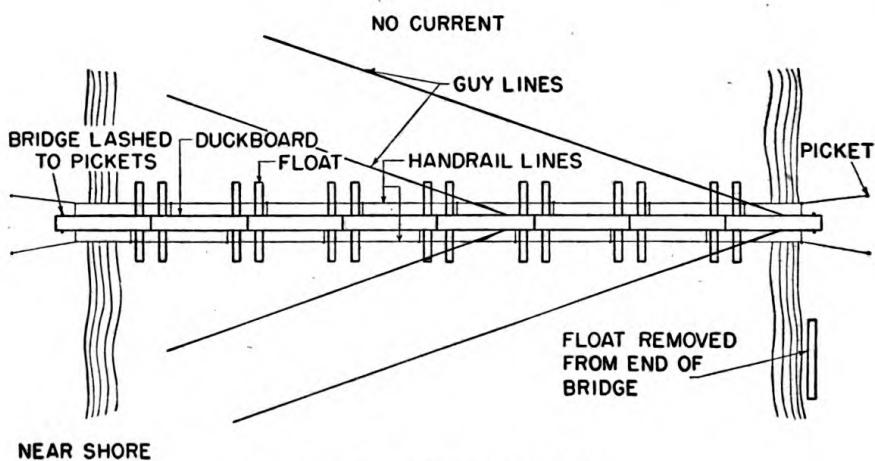


FIGURE 96. *Use of guy lines.*

missioned officer in charge of guy-line detail indicates location and number of lines to be attached, and location of hold-fasts for them. Lines are made fast to duckboards. First two lines are made fast to riverward end of bridge. (See figs. 96 and 101.) Men take positions at designated hold-fasts and pay out lines, snubbing around hold-fasts when necessary to maintain alignment of bridge. When bridge is completed it is aligned and guy lines made fast to shore pickets.

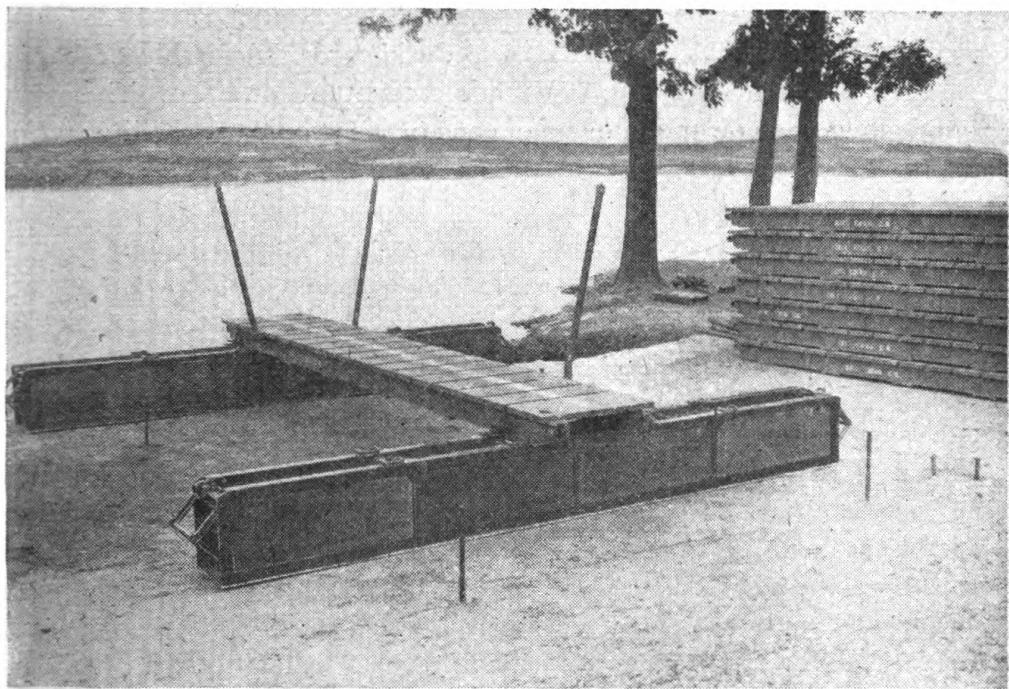


FIGURE 97. *Template for assembling bay.*

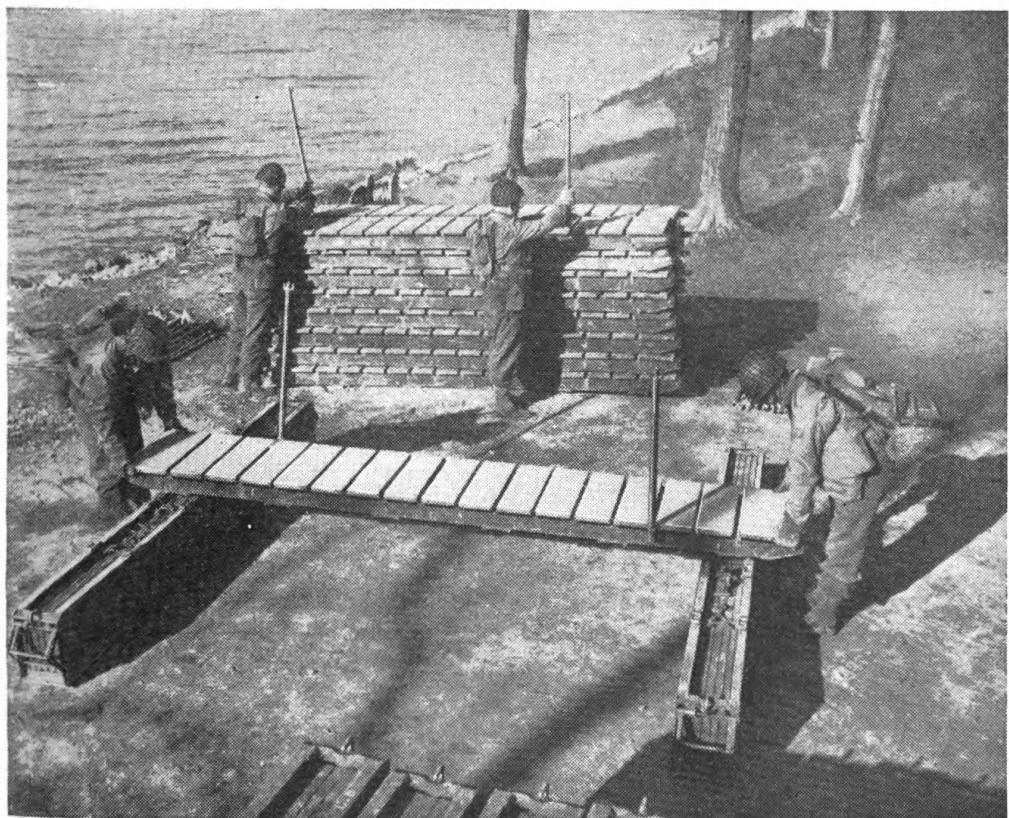


FIGURE 98. *Assembly of bay.*

e. Assembly of bays. (1) The shore-assembly detail attaches duckboards to floats and fastens handrails to duckboards. Assembly of bays is facilitated by a template (fig. 97) made of driftpins or stakes driven into ground along one side and one end of each of the two floats. White tracing tape stretched between stakes or driftpins aids in assembly when bridge is constructed at night.

(2) Four men, two to each float, procure floats and place them in templates. Two men attach handrail posts to duckboard and two other men place duckboard on floats (fig. 98). As soon as duckboard is placed, men placing floats connect them to it by the fasteners. (See fig. 89.)

f. Movement of assembled bay to bridge. Assembly-carrying detail removes bays from template, carries them to river, and launches them.

One man carries one end of each float of bay. Bay is picked up from template, carried into water, and turned over to river-assembly detail at a point near completed portion of bridge (fig. 99).

g. Attaching bay to completed portion of bridge. River-assembly detail attaches bay to shoreward end of completed bridge. The connection is made as follows: Four men move bay through water to end of bridge. Noncommissioned officer kneels on last bay of bridge, guides the joints together, and assists in making connections (figs. 100 and 101). Two men of detail who hold near-shore end of the bridge also assist in making connection. After male and female joints have been connected, completed portion of bridge is moved riverward 12 feet and held there by two men.

h. Attaching handrail lines. One man of handrail detail makes lines fast to river end of first duckboard and then takes post on bridge near inshore end, threading handrail lines through handrail posts on each side as bridge is pushed out. (See fig. 100.) Two men remain on near shore, one upstream and one downstream from bridge, to pay out handrail lines and make them fast to near shore when bridge is completed. Far-shore detail makes fast ends of lines when bridge reaches far shore. Handrail lines are fastened to steel pickets on both shores.

i. Fastening shoreward duckboards. Two men from shore-assembly detail place two pickets approximately 1 foot from shoreward end of near-shore duckboard, and lash duckboard stringers to pickets. Two men from shore-assembly detail do likewise on far-shore end of bridge. (See fig. 102.)

116. DISMANTLING BRIDGE. Working details for dismantling are the same number and size as for construction. In general, the procedure is the reverse of bridge assembly. An exception is the float cable, which is taken in at once to expedite removal of bays from the bridge. After the float cable has been removed, care must be exercised not to overload the bridge.



FIGURE 99. *Carrying assembled bay to waterway.*

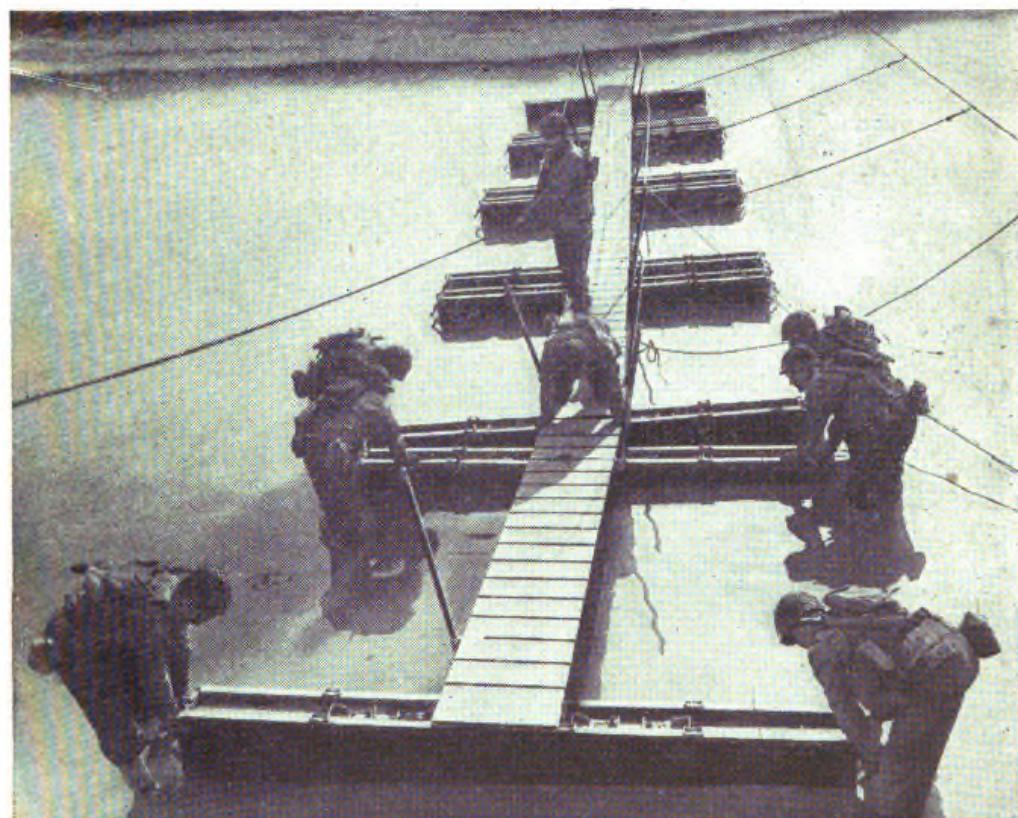


FIGURE 100. *Bay being connected to completed portion of bridge.*

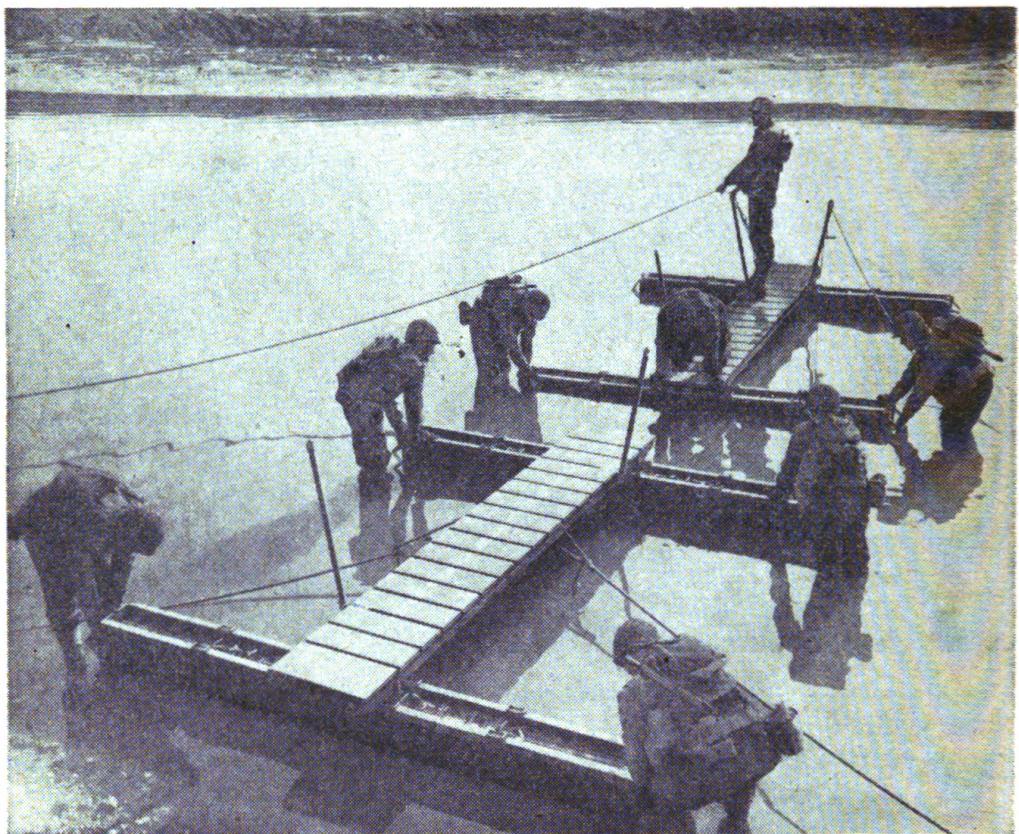


FIGURE 101. Bay with guy lines attached being connected to bridge.

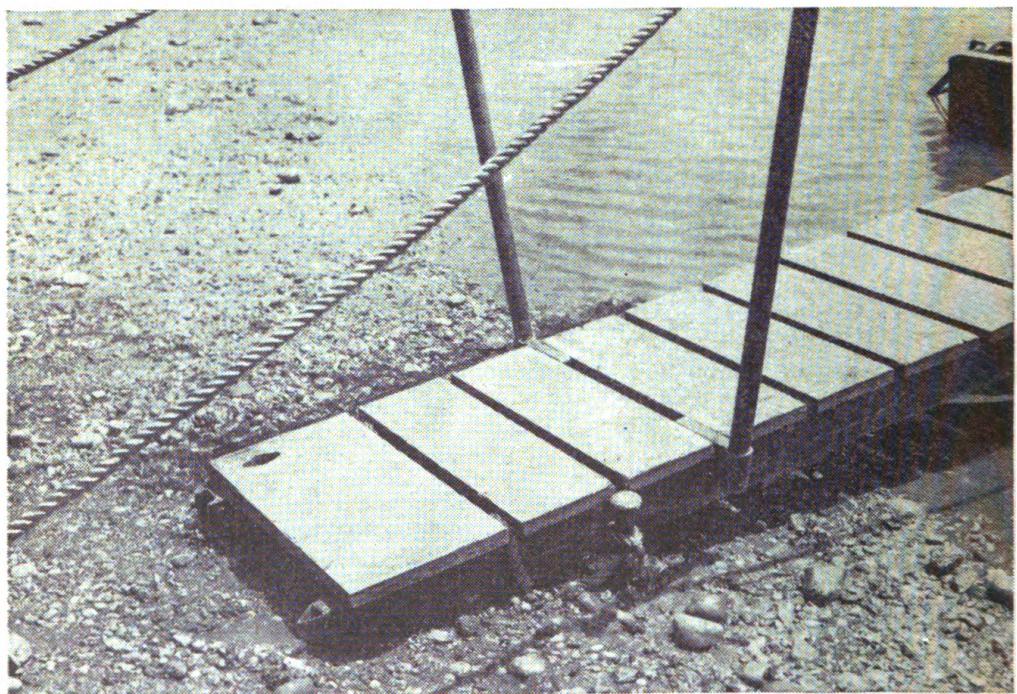


FIGURE 102. Duckboard fastened to shore.

Section V

Reinforced Bridge

117. ASSEMBLY OF BAY. The reinforced bridge bay consists of three duckboards, six floats, and two handrail posts (fig. 103). From one unit of bridge 144 feet of reinforced bridge can be constructed.

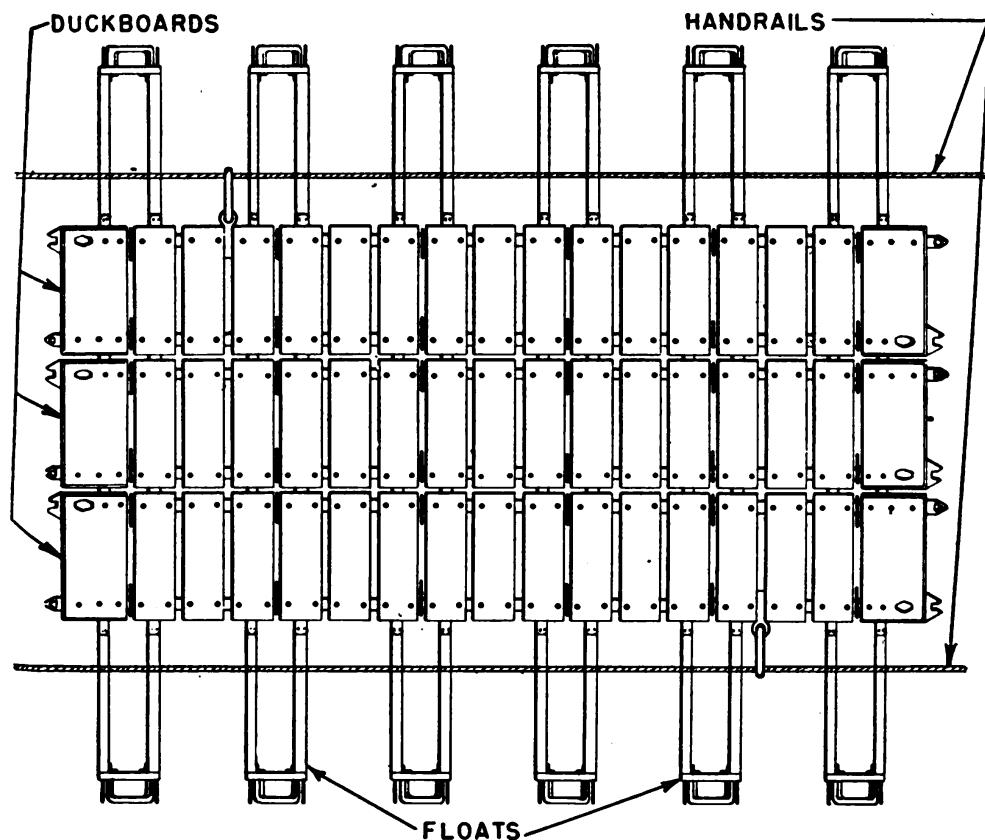


FIGURE 103. *Assembled bay of reinforced bridge.*

118. ANCHORAGE. Because of increased float resistance to the current, anchor cables and float cables are required with the reinforced bridge when it is carrying maximum loads.

119. CONSTRUCTION. Anchor-cable, bridle-line, handrail-line, and river-assembly details of the same size as for the normal bridge are required. Two or more shore-assembly details are required, each of 1 noncommissioned officer and 10 men. The assembly-carrying detail is increased to 1 non-commissioned officer and 12 men. With at least 2 shore-assembly details working, the reinforced bridge can be constructed in about twice the time required for the same length of footbridge. (See table X.)

120. CAPACITY. Reinforced bridge will carry—

- a. 37-mm antitank guns towed by hand.
 - b. Foot troops in column of threes at a walk, at rate of 100 men per minute.
 - c. Foot troops in column of twos at a run, at rate of 150 men per minute.
 - d. Horses may be crossed with wide intervals when float cables are used.
- Motorcycles with sidecars also may cross.

Section VI

Maintenance and Transportation of Equipage

121. MAINTENANCE OF EQUIPAGE. **a. General.** All parts of bridge equipage should be carefully inspected at frequent intervals. Damaged or broken parts should be repaired or replaced, and all parts cleaned, painted, and greased as required. A well-ventilated shed or building should be used for storing equipment. Floats and duckboards should be kept from contact with ground and piled to permit ventilation through the stacks. Standard olive-drab paint is suitable for painting parts needing it.

b. Duckboards. In disassembling the bridge, the duckboard fasteners and wooden parts should be handled carefully. There is much less danger of damage during dismantling if each bay is removed from the bridge while still afloat. In disconnecting bays from remainder of the bridge, the lug on the end of the handrail post should be used only as a key to separate the spring leaves by turning the post about its axis through an angle of 90°. When the joint does not disengage easily, separation should be accomplished by jiggling and working the parts rather than by attempting to force them apart. Prying the bridge apart with the handrail posts results in damage to both floor boards and handrail posts.

c. Floats. Since excessive heat or oil damages the rubber blocks used in floats, the floats should not be stored indoors next to stoves, radiators, or steam pipes, nor outdoors in the sun. The surfaces of the rubber blocks become brittle in time. Tears and abrasions of the surface accelerate deterioration. The fasteners which connect floats to duckboards should be secured by the spring clips provided. These fasteners should be kept clean, and washed, dried, and oiled before the floats are placed in storage.

d. Handrail posts. The handrail posts are not designed for use as crowbars and must not be used as such.

e. Rope. Rope should be kept dry and clean and should be carefully washed, dried, and coiled before storing. The harness snaps on the anchor lines also should be cleaned, dried, and oiled before storing.

f. Cables. Particular care should be taken to avoid kinking cables. When securing the ends of a cable to hold-fasts, a suitable loop should be formed and secured with cable clips. Knots should not be used in fastening either end. Formation of loops except near an end of the cable should be avoided.

122. TRANSPORTATION. a. Four 1½-ton trucks. The standard load for a 1½-ton truck is 108 feet of bridge. Four 1½-ton trucks are required to carry one unit.

b. Three 2½-ton trucks. The standard load for 2½-ton truck is 144 feet of bridge. Three 2½-ton trucks are required to carry one unit (fig. 104).

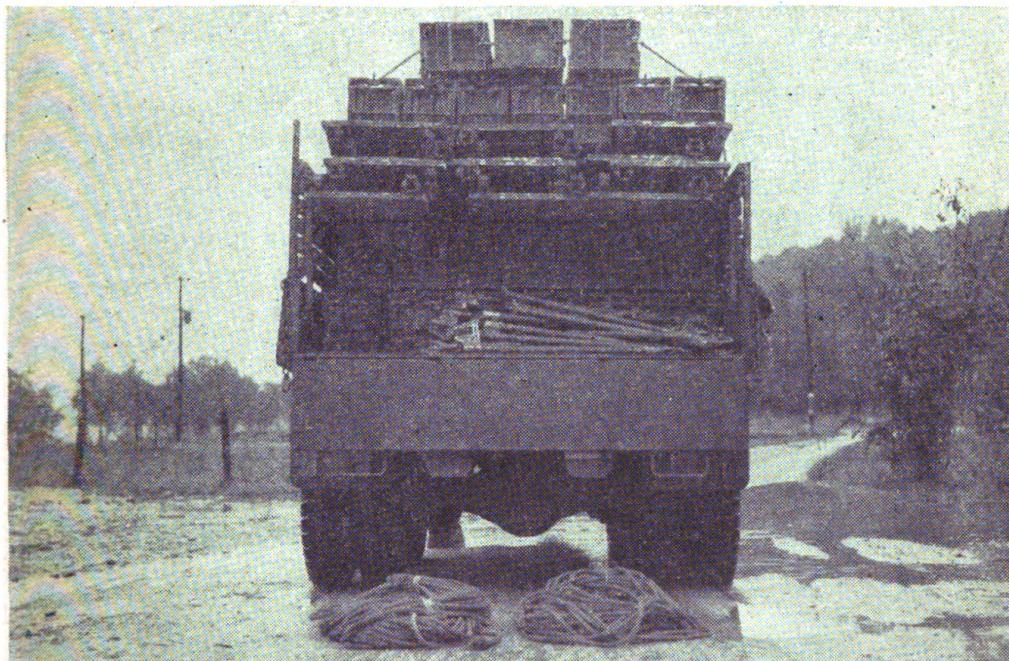


FIGURE 104. *Footbridge equipment loaded on 2½-ton truck.*

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